

The Technical Basis for Siting Additional Ambient Air Monitoring Stations for the Measurement of Tritiated Water Vapor at Lawrence Berkeley National Laboratory

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EXECUTIVE SUMMARY

This report describes the technical basis used to determine the placement of ambient air monitoring stations for the measurement of tritium at Lawrence Berkeley National Laboratory (LBNL).

The present ambient air monitoring network at LBNL includes 7 stations that use silica gel samplers to detect the presence of tritiated water vapor (HTO) in air. These stations meet all criteria mandated by the U.S. Department of Energy (DOE), which include coverage of the major wind sectors and siting at the nearest offsite location where a maximally exposed individual could receive an effective whole body dose exceeding 1 mrem/y. Releases of tritium from the National Tritium Labelling Facility (NTLF) at LBNL have been sufficiently low that exposures to individuals onsite and offsite have not exceeded (or even approached) 1 mrem/y. The applicable dose limit representing the National Emission Standard for Hazardous Air Pollutants (NESHAP) is 10 mrem/y.

Despite the fact that the present network satisfies all applicable requirements, an expansion of the network to 15 stations is presently proposed by LBNL. Two sites are proposed to address a supplemental monitoring request made by the Environmental Protection Agency (EPA) that will allow the agency to complete its evaluation of LBNL for possible listing as a Superfund site. Six sites have been proposed in response to recommendations made by an independent review of LBNL operations performed for the City of Berkeley (Franke and Greenhouse, 2000; 2001), and to concerns expressed by members of the Environmental Sampling Project Task Force. The locations for the additional 6 proposed monitoring stations were selected using the following siting criteria:

- the location of employees onsite and population centers offsite,
- the potential to represent each of the 16 standard wind sectors,
- the distance out to which HTO is measurable,
- the availability of dedicated electrical service,
- safe access to the monitoring station, and
- the ability to house and secure instruments.

Annual averaged air concentrations were estimated for annual releases of HTO of 30 Ci from the planned Building 75 rooftop stack at various distances and directions from the NTLF out to a radius of 5 km with the CALPUFF modeling system, which accounts for changes in local air movement due to the effects of complex terrain (Scire et al., 1999). A release of 30 Ci of HTO per year represents an emission rate anticipated from future normal operations of the NTLF based on an evaluation of releases for the past six years.

CALPUFF predictions of onsite air concentrations produce maximum concentration isolines of 10 to 20 pCi/m³, diminishing to 10 to 0.1 pCi/m³ offsite. Similar concentrations were produced with a wind tunnel study (White, 2001) and with the NESHPAs compliance code, CAP88-PC; however, the spatial pattern of tritium dispersion differed among all three methods. Differences between CALPUFF and the wind tunnel dispersion patterns are due to the inability of the wind tunnel to simulate hourly variations in atmospheric turbulence. Differences between CALPUFF and CAP88-PC are because CAP88-PC does not account for variations in wind direction and turbulence under complex terrain conditions that prevail at LBNL.

For an annual release of 30 Ci of HTO, the maximum onsite dose to a worker exposed during an average work year would be less than 0.032 mrem/y, regardless of which method is used to estimate downwind air concentrations of tritium. The maximum dose to an offsite resident exposed 24 hours per day would be less than 0.087 mrem/y. Effective whole body doses less than 1 mrem/y are considered negligible by the National Council on Radiation Protection and Measurements (NCRP).

This proposed network provides monitoring coverage in all standard wind directions within the limits of practicality of the complex LBNL site and, if implemented, will enhance the opportunity to validate and calibrate mathematical models that are used to estimate onsite and offsite air concentrations at locations not represented by an ambient air monitor.

ACKNOWLEDGMENTS

We would like to acknowledge Dr. Bruce White from the University of California at Davis who developed a scale model of the LBNL site for wind tunnel studies on the atmospheric dispersion of HTO released from the Building 75 rooftop stack and for sharing unpublished results, which are included in Section 3.2 of this report.

We also wish to acknowledge contributions from the following individuals at LBNL: Patrick Thorson for help in obtaining information on the criteria used by LBNL for siting existing monitoring stations, Henry Tran for providing us with estimated air concentrations using the CAP88-PC computer code, Michael Ruggieri for researching the background levels of tritium, and Ron Pauer for his review and comments on previous versions of this manuscript.

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1.0 INTRODUCTION

Lawrence Berkeley National Laboratory (LBNL) has operated an ambient air tritium monitoring network for nearly three decades. LBNL currently has a network of 7 ambient air monitoring stations for the measurement of airborne tritium released from the National Tritium Labelling Facility (NTLF) that use silica gel to trap tritiated water vapor (HTO).

The primary purpose of the existing network has always been to provide assurance to the Department of Energy that the environmental impacts from operations at the Laboratory satisfy both environmental regulations and DOE's internal set of orders.

In the case of tritium, the applicable environmental regulation is 40 CFR Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities" or NESHAPs for short. This NESHAPs regulation was first promulgated in 1989. Compliance with this regulation is based on an annual dose that is predicted by using EPA prescribed dispersion modeling of emissions. Ambient monitoring, although not required to establish NESHAPs compliance, is extremely useful in validating the predictions made with the model.

The primary reference that specifies the characteristics of the existing ambient air network is the DOE Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE, 1991). This reference guide specifies three factors that have traditionally determined the number and placement of sampling locations in the network: meteorology, demography, and the magnitude of projected doses to the surrounding population. Although the existing monitoring network meets all requirements in this DOE guide, LBNL is currently planning a significant expansion to its ambient air monitoring network. This expansion is in response to requests and concerns raised by members of the Environmental Sampling Project Task Force, recommendations made by the independent evaluation of LBNL operations for the City of Berkeley (Franke and Greenhouse, 2000; Franke and Greenhouse, 2001), and a request from EPA for two additional stations to supplement its ongoing Hazard Ranking System

scoring evaluation. The location for 6 of the 8 proposed sampling stations is based on the technical criteria described in Section 2.0, the dispersion modeling of annual averaged downwind air concentrations for a release of 30 Ci/y of HTO, and the considerations of the distances out to which average air concentrations of HTO are detectable. A discussion of the rationale for each monitoring location is given in Section 5.0 of this document.

2.0 SITING CRITERIA

The existing monitoring stations were sited based on the criteria given in DOE's Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE, 1991). The regulatory guide states that the exact number of samplers required at a particular site will be determined by the local meteorology, demography, and the magnitude of projected doses to the surrounding population. The DOE regulatory guide states that offsite air samplers should be placed at each DOE site having potential airborne releases that could result in an annual effective dose equivalent greater than 1 mrem per year to the maximally exposed individual. We note that at no time, either during present or past operations of the NTLF, have onsite or offsite air concentrations of HTO approached 1 mrem/y.

The placement of the additional ambient air monitors was based on criteria above and beyond the guidance provided by DOE. These criteria include the location of nearby population centers (both onsite and offsite), placement of monitors with respect to the 16 standard wind sectors, and whether the site would be able to detect tritium as HTO. Other criteria include the availability of dedicated electrical service and whether the site is easily and safely accessible and can support housing to secure instrumentation.

2.1 Location of Nearby Population Centers

A primary consideration in the placement of ambient air monitoring stations is the location of potentially exposed populations, both onsite and offsite. Priority for establishing the location of air monitoring stations is given to sites where individuals are likely to be exposed, including sites where people live, work, or visit.

2.2 Standard Wind Directions

The existing monitoring stations and the 16 standard wind sectors have been identified on an LBNL site map (Figure 1). Although observed wind patterns at the LBNL site indicate that the wind blows very rarely from some directions (e.g., the N, NNE, NE and ENE wind sectors), placement of the monitoring systems to represent the 16 standard wind sectors will assure that all releases from the NTLF, regardless of the direction that the wind is blowing during the time of release, will likely be monitored.

2.3 Expected Concentration to Occur at a Given Location

The analytical method used by the laboratory for processing samples from the ambient air monitors can detect concentrations of HTO as low as 2 to 5 pCi/m³ for the given flow rate used by the LBNL sampling stations. It is desirable to place a monitor where it is likely to detect a tritium release. Estimation of annual averaged air concentrations downwind of the NTLF have been performed in the report using the CALPUFF modeling system that accounts for the changes in local patterns of air movement due to the effects of complex terrain (see Section 3.0).

2.4 Power, Accessibility, and Security

When siting ambient air monitors, several issues of practicality must be considered. The sampling equipment requires dedicated electric power. Once per month, an LBNL technician visits the monitoring station to collect the silica gel sample and send it to a laboratory for analysis; therefore, it is important that the monitoring site be safely accessible. Finally, it is imperative that the monitoring stations be placed in a location that will support housing and security to reduce opportunities for vandalism or tampering with equipment.

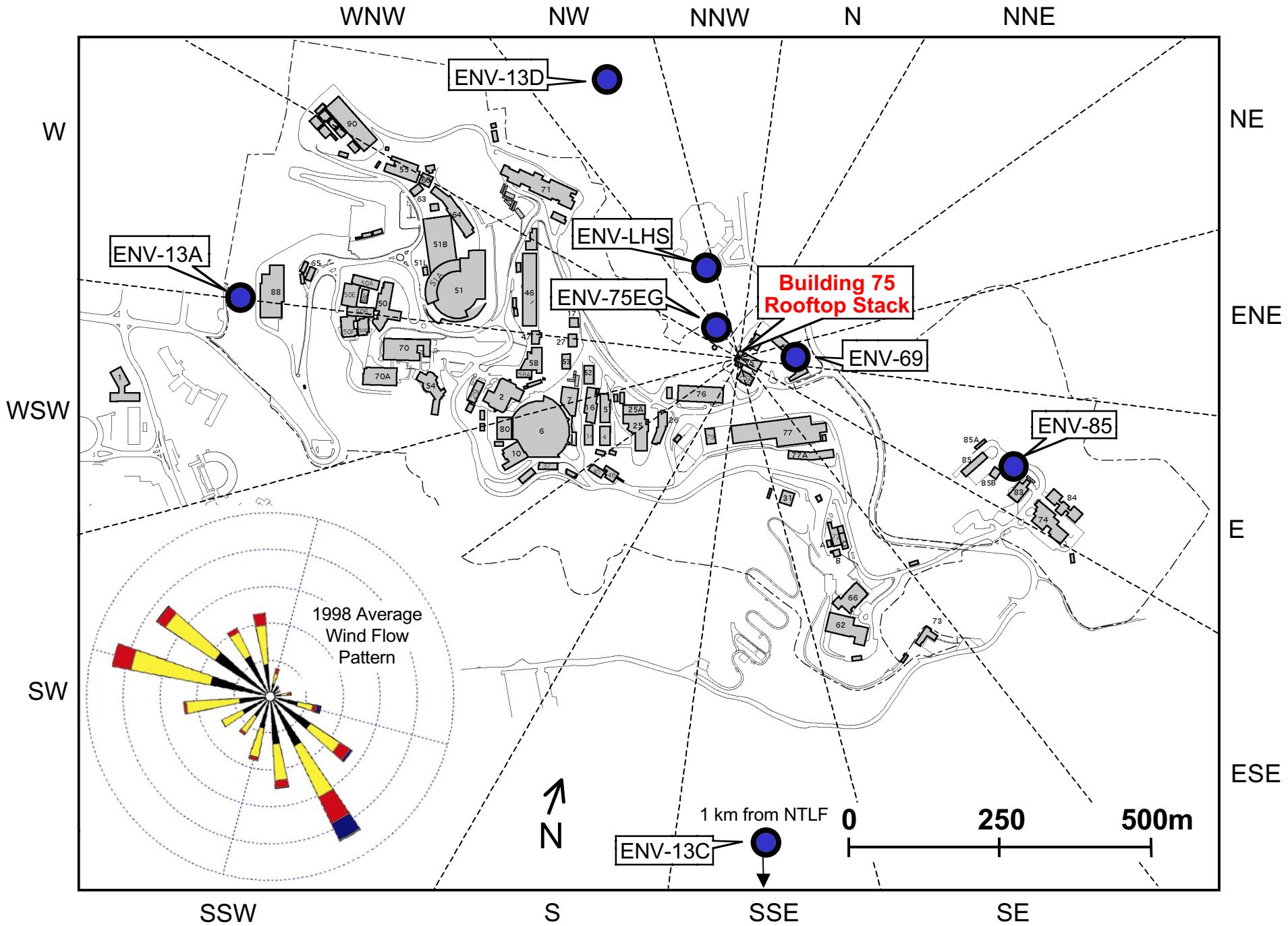


Figure 1. Sixteen standard wind sectors and existing monitoring locations.

3.0 ESTIMATED AIR CONCENTRATIONS OF HTO

Air concentrations have been estimated downwind from the NTLF using the CALPUFF modeling system (Scire et al., 1999) for the purposes of siting new monitoring stations. The results from CALPUFF have been compared to the results from the UC Davis Wind Tunnel studies and predictions made using the EPA regulatory model CAP88-PC (Parks, 1997).

The concentrations estimated in this report are based on the following conditions and assumptions:

- All releases occur from the planned Building 75 rooftop stack. This relocation is planned for this fiscal year ending 9/30/2001 and will replace the hillside stack.
 - The stack height above the ground is 9.1 meters (the building is 4.5 meters tall plus a 4.6 meter rooftop stack).
 - Stack diameter = 0.57 meters
 - Exit velocity = 11.9 m/s
 - Exit temperature = 20 C
- Meteorological data are from 1998 records at the onsite 20-meter tower.
- Emissions were assumed to be constant over the year for an annual release of 30 Ci.

Although short-term deviations from the annual average will occur, annual averaged air concentrations are the most relevant indicators of the potential for long-term exposure to individuals on and offsite. The potential impacts of short-term exposures coinciding with short-term emissions have been addressed in a previous report (Thomas and Hoffman, 2000) and were found to be much less than the cumulative exposure that would occur over an extended period of time (one year or longer).

An annual release of 30 Ci of HTO per year represents an emission rate anticipated from future normal operations of the NTLF, based on an evaluation of releases for the past six years. Table 1 below contains the annual average release amounts from 1995-2000.

Table 1. Annual tritium releases from the National Tritium Labelling Facility

Year	Total Tritium Released (Ci)
1995	53
1996	5
1997	41
1998	115 ^a
1999	30
2000	25 ^b

^a Includes the July 1998 one-time accidental release of 35 Ci.

^b Value not yet officially verified.

The values in Table 1 are totals for releases of HTO and HT combined. The estimates in this report conservatively assume that all releases are as HTO and may lead to an overestimate of HTO at distances near in to the NTLF rooftop stack. This assumption that all releases occur as HTO will also overestimate human exposures and doses as HTO is more readily taken up and retained by biological systems than is HT (NCRP, 1979).

3.1 CALPUFF Modeling System

The placement of additional monitors in the proposed network of ambient air monitors has been based on air concentrations estimated using the CALPUFF modeling system. CALPUFF is a non-steady-state air quality modeling system that consists of a meteorological modeling package (CALMET) with both diagnostic and prognostic wind field generators, a Gaussian puff dispersion model (CALPUFF) with chemical removal, wet and dry deposition, complex terrain algorithms, building downwash, plume fumigation, and other effects, and postprocessing programs (CALPOST) for the output fields of meteorological data, concentration and deposition fluxes (Scire et al., 1999). The applicability of the CALPUFF model to the LBNL site has been discussed in detail in a previous report (Thomas et al., 1999). CALPUFF has been applied and calibrated to the LBNL site in previous studies (Radonjic et al., 2000; Thomas and Hoffman, 2000; Thomas et al., 2000).

A summary of the reasons why CALPUFF was selected for this application include:

- Complex terrain transport of airborne materials is considered explicitly.
- The transport and dispersion of releases of HTO can be estimated from tens of meters to hundreds of kilometers.
- Estimates of air concentrations can be made for averaging times ranging from one hour to one year.

In addition, the Environmental Protection Agency (EPA) has proposed the CALPUFF modeling system as a *Guideline* model for use in regulatory applications for near-field conditions where non-steady-state effects (e.g., spatial variability in meteorological fields, calm winds, fumigation, recirculation or stagnation, and terrain or coastal effects) may be important.

Estimated downwind air concentrations for the modeled release were then plotted as contour lines on a base map of the region using SURFER computer software (Kekler, 1995). Surfer employs the Kriging interpolation technique among locations where specific concentrations are specified by CALPUFF. The input and output files for CALPUFF are provided in Appendix A.

Annual averaged air concentrations of HTO estimated out to a radius of approximately 1 km from the NTLF are presented in Figure 2. Estimates out to a radius of a 5 km are given in Figure 3 to show the location of stations ENV-13C and ENV-AR, and to show the full extent of concentration isolines down to levels as low as 0.1 pCi/m^3 . Natural background levels of HTO are at 0.1 to 0.4 pCi/m^3 (IAEA, 1999; LLNL, 1998). The releases from the NTLF are incremental increases above this level.

The solid lines depict regions within which a silica gel sampler will likely be capable of detecting annual averaged concentrations of HTO in air. The dashed lines represent concentrations that are less than the limits of analytical detection for tritium. Based on CALPUFF estimates for a 30 Ci annual release, 9 monitoring stations (4 existing and 5 proposed) are sited in a location that will likely permit detection of a release of tritium from the NTLF.

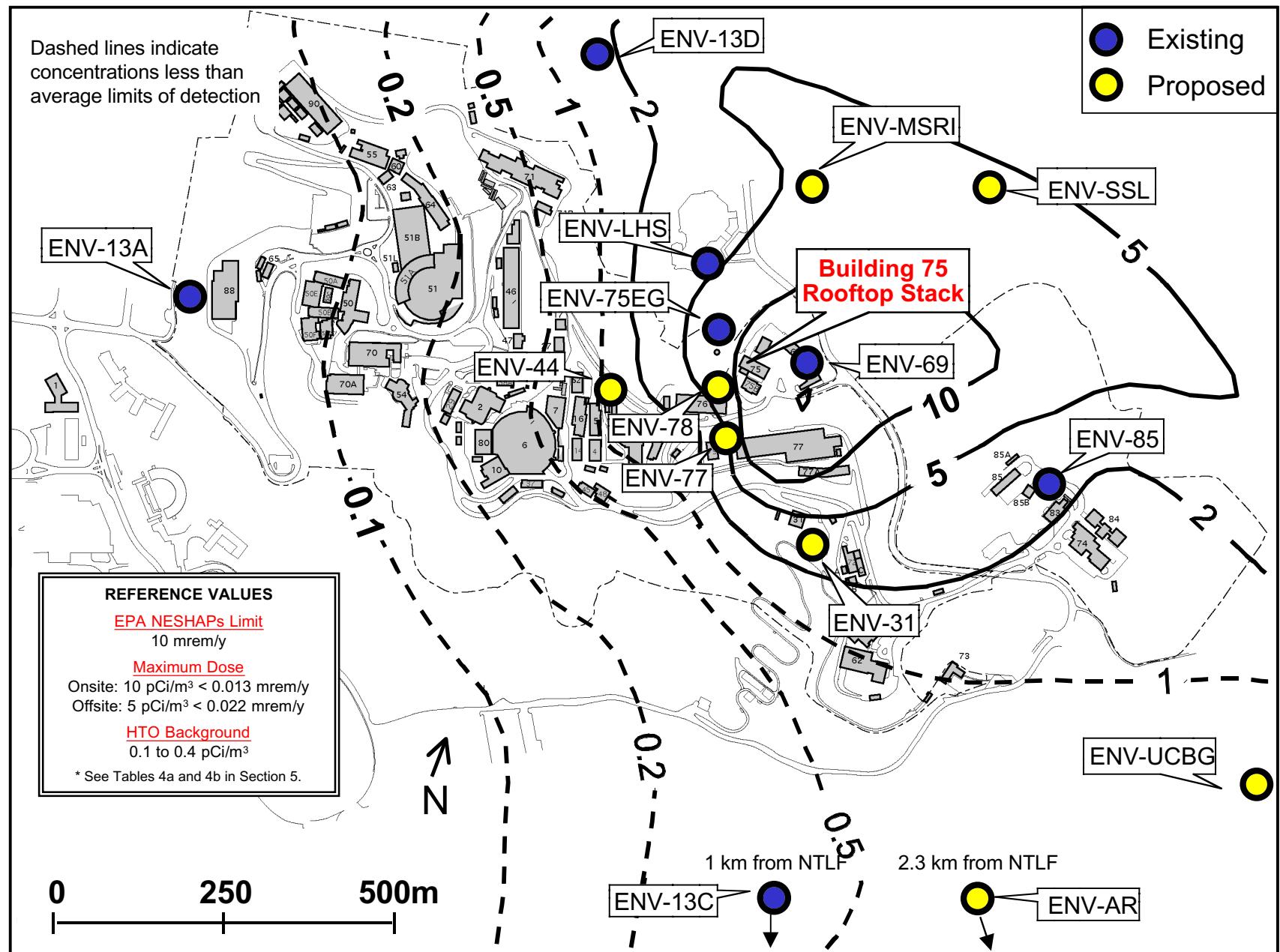


Figure 2. CALPUFF predictions of tritium air concentrations (pCi/m^3) for a 30 Ci annual release of HTO plotted on a site map of approximately 1 km radius.

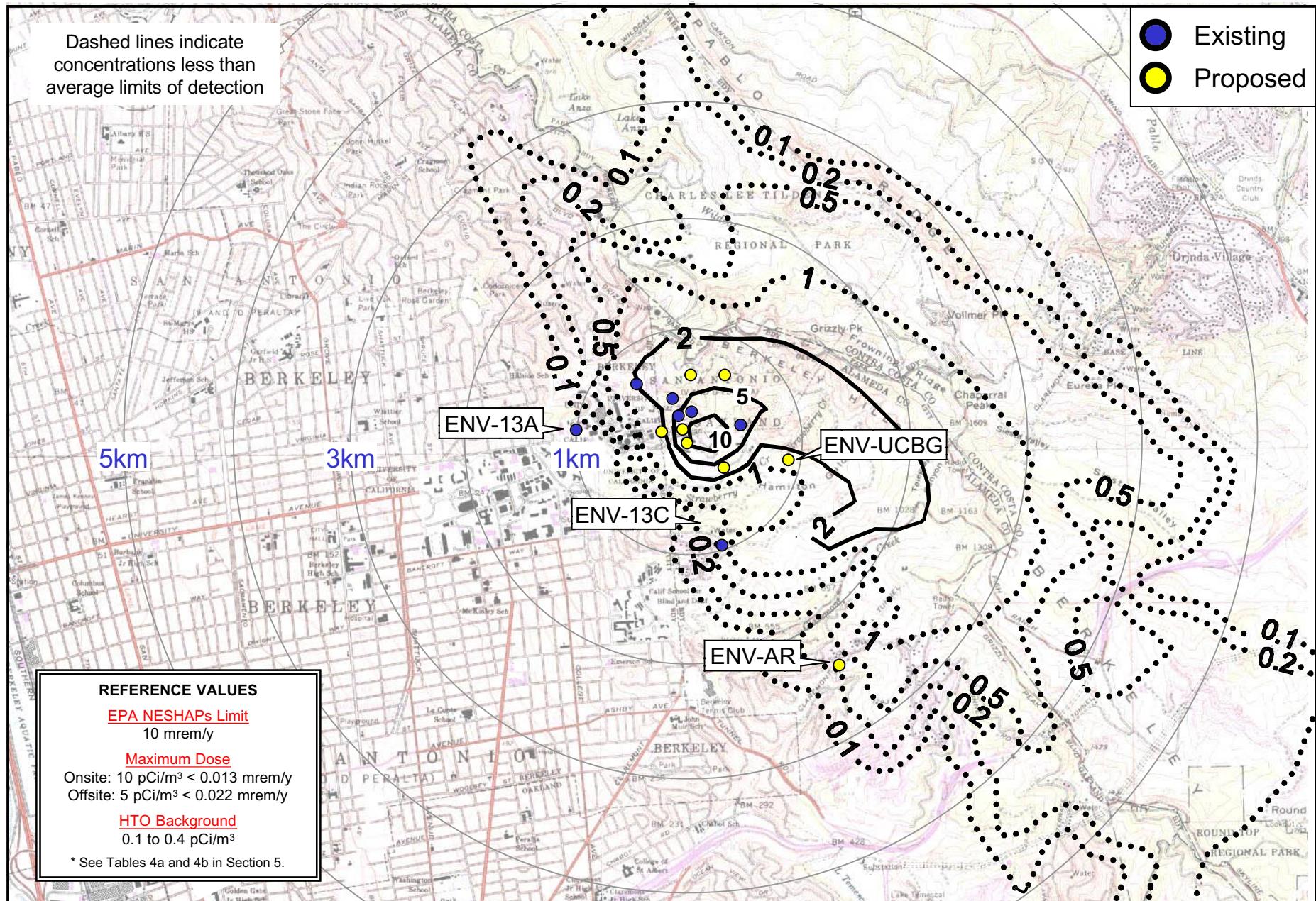


Figure 3. CALPUFF predictions of tritium air concentrations (pCi/m^3) for a 30 Ci annual release of HTO plotted on a site map of approximately 5 km radius.

3.2 Wind Tunnel Studies

The University of California at Davis has performed a wind tunnel study of the LBNL site. A scale model of the site, including buildings, topography, and ground cover, was created for this purpose (White, 2001). Wind tunnel data are provided in Appendix B.

Concentrations of HTO in air estimated by the wind tunnel study for an annual release of 30 Ci are presented in Figure 4. The isoconcentration lines generated from the wind tunnel data indicate less dispersion than was estimated using CALPUFF, especially in the NE direction. This difference is primarily due to the fact that the wind tunnel study can simulate changes in wind direction but cannot account for changes in atmospheric stability. The conditions in the wind tunnel are representative of atmospheric stability category B. On the other hand, CALPUFF incorporates hourly data that includes variations on atmospheric stability. Unlike dispersion models, the wind tunnel model is capable of taking into account site-specific surface roughness caused by the presence of buildings and vegetation.

While the patterns of dispersion predicted by the two approaches (CALPUFF and wind tunnel study) differ, the magnitude of the concentrations estimated by each approach are comparable.

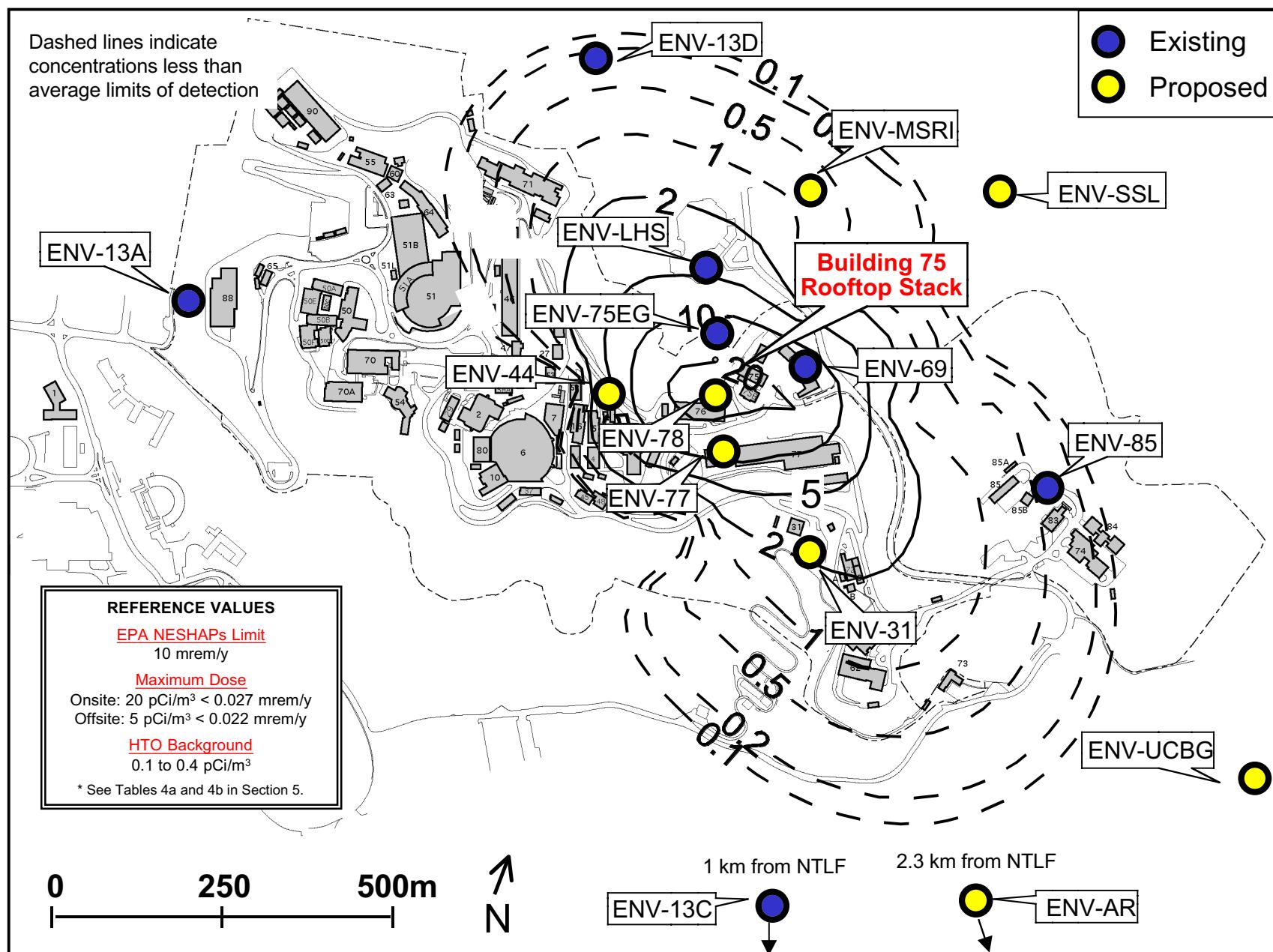


Figure 4. UC Davis wind tunnel predictions of tritium air concentrations (pCi/m^3) for a 30 Ci annual release of HTO plotted on a site map of approximately 1 km radius.

3.3 CAP88-PC Regulatory Model

Predictions from the EPA regulatory model CAP88-PC (Parks, 1997) have also been reviewed. The input and output files for CAP88-PC are provided in Appendix C. The concentrations depicted in Figure 5 are conservative due to simplifications made in the construction of the CAP88-PC computer code. For example, the CAP88-PC predictions are based on the assumption that the material was released over flat terrain.

The results from CAP88-PC have not been used for siting monitoring stations because downwind air concentrations produced with CAP88-PC are known to overestimate true concentrations (Thomas et al., 2000). For example, the results in Figure 5 suggests that at least 12 of the 15 monitoring stations discussed in this report would detect tritium released from the NTLF (only stations ENV 13A, ENV-SSL, and ENV-AR would be outside the range where tritium would likely be detected). By comparison, CALPUFF (Figure 3) indicates that 6 stations are outside the range of detection. The use of CAP-88 should be limited to the determination of whether NESHAP standards for the maximally exposed individual (MEI) are met or exceeded.

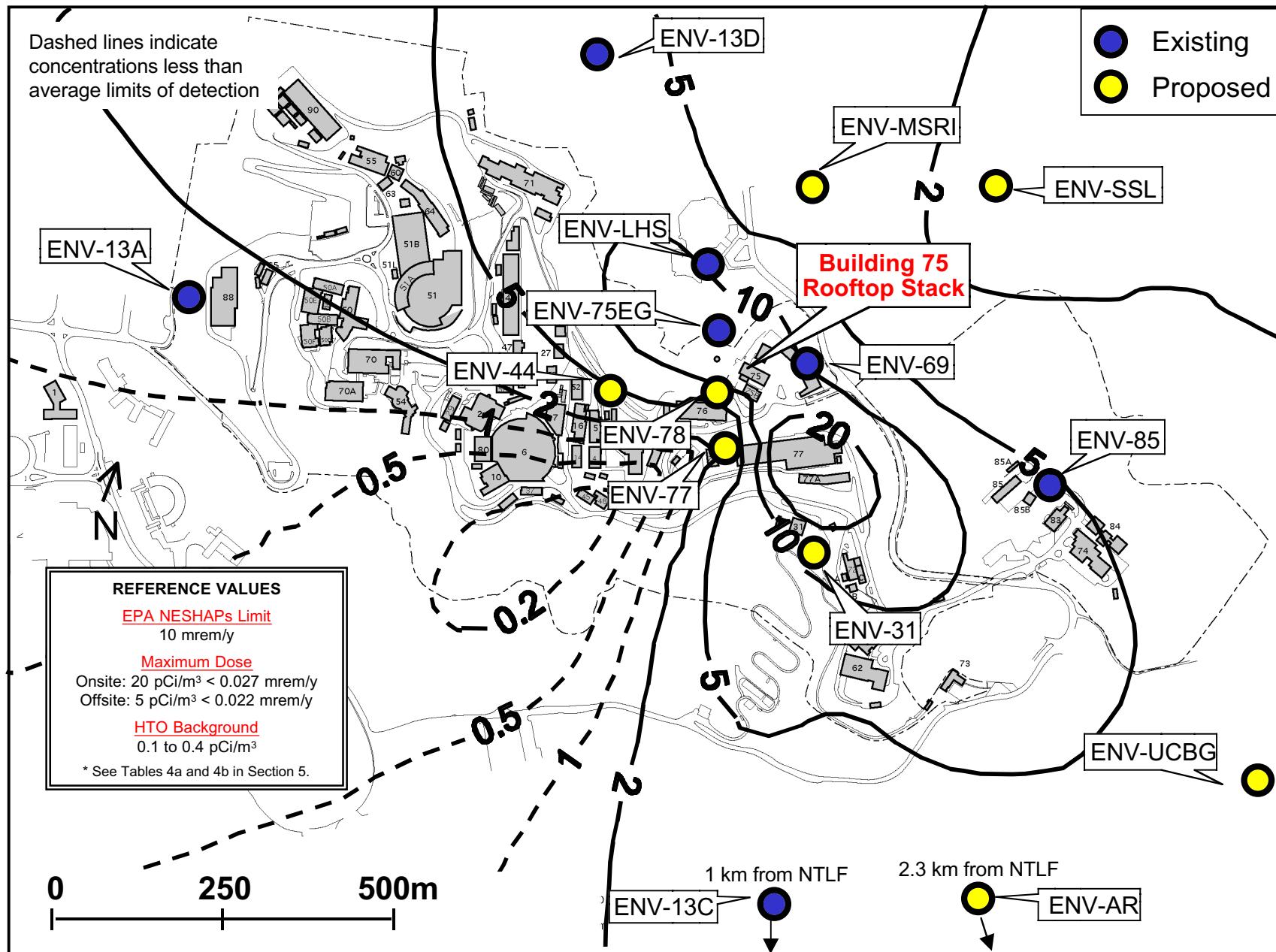


Figure 5. CAP88 predictions of tritium air concentrations (pCi/m^3) for a 30 Ci annual release of HTO plotted on a site map of approximately 1 km radius.

4.0 THE TECHNICAL BASIS FOR SITING EXISTING AND PROPOSED MONITORING STATIONS

The rationale for placement of existing and proposed ambient air monitoring stations is discussed below. The location of each monitoring station is identified in Figures 2 through 6. A checklist is provided of siting criteria for existing monitoring sites (Table 2) and for the proposed monitoring locations (Table 3). For all existing and proposed sites, it is implied that the practical considerations of power, accessibility, and security are all satisfied.

4.1 Existing Sites

A detailed description of each existing LBNL ambient air monitoring location is given below. Table 2 includes a checklist of siting criteria for the existing stations.

ENV-13A

Station ENV-13A is located at the western edge of the LBNL property that borders the UC-Berkeley campus and residential neighborhoods of Berkeley. ENV-13A sampling station was sited to measure tritium from any source at LBNL that may be transported toward the most densely populated area surrounding the Lab. This site has been strategically placed to increase the likelihood of detecting an unusual release of tritium. Surrounding trees and buildings have only a minimal influence on this monitor.

ENV-13C

Station ENV-13C is an existing monitor located off site on the southern side of Strawberry Canyon near Panoramic Way at approximately the same elevation as the NTLF. While not truly a background site by definition, this site is an offsite monitoring location where impacts from LBNL have shown to be non-detectable or negligible. This site is representative of offsite tritium concentrations in the residential, recreational, and ecological study area that borders the southern edge of the LBNL property.

Table 2. Checklist of siting criteria for the existing LBNL ambient air monitors^a.

Monitoring Site	Direction From NTLF	Located Within Limits of Detection ^b (30 Ci) ^c	Power Accessibility Security	Nearby Onsite Receptor	Nearby Offsite Receptor	Detect Other Sources ^d	Dose > 1 mrem/y
ENV-13A	W, WSW	No	✓	✓	✓	✓	No
ENV-13C	SSE	No	✓	No	✓	✓	No
ENV-13D	NW	No	✓	No	✓	No	No
ENV-69	ENE	✓	✓	✓	No	No	No
ENV-75EG	WNW, NW	✓	✓	No	No	No	No
ENV-85	E	✓	✓	✓	No	✓	No
ENV-LHS	NW, NNW	✓	✓	No	✓	No	No

^a All stations in the existing network except ENV-75EG satisfy criteria in DOE's Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE, 1991). ENV-75EG was sited in response to concerns from the community.

^b Defined as 2 to 5 pCi/m³.

^c Assuming an annual averaged release of 30 Ci HTO from the NTLF.

^d Monitors sited to detect emissions from any LBNL source other than NTLF emissions. However, the additional sources account for less than 0.2% of the total emissions.

Table 3. Checklist of siting criteria for additional ambient air monitors^a.

Monitoring Site	Direction From NTLF	Located Within		Power Accessibility	Nearby Onsite Receptor	Nearby Offsite Receptor	Detect Other Sources ^d	Dose > 1 mrem/y
		Limits of Detection ^b (30 Ci) ^c						
ENV-31	SE	✓		✓	✓	No	✓	No
ENV-44	SW, WSW	No		✓	✓	No	No	No
ENV-77	S	✓		✓	✓	No	No	No
ENV-78	SSW	✓		✓	✓	No	No	No
ENV-AR ^d	SE	No		✓	No	✓	No	No
ENV-MSRI	N	✓		✓	No	✓	No	No
ENV-SSL	NNE, NE	✓		✓	No	✓	No	No
ENV-UCBG ^d	ESE	No		✓	No	✓	✓	No

^a All additional proposed stations were sited for reasons above and beyond the criteria given in DOE's Regulatory (DOE, 1991). Stations ENV-UCBG and ENV-AR have been selected in response to a supplemental monitoring request from EPA to provide sampling data in the HRS target ring distance category of 0.5 to 1 miles and the HRS target ring distance category of 1 to 2 miles, respectively.

^b Defined as 2 to 5 pCi/m³.

^c Assuming an annual averaged release of 30 Ci HTO from the NTLF.

^d Monitors sited to detect emissions from any LBNL source other than NTLF emissions. However, the additional sources account for less than 0.2% of the total emissions.

Like Station ENV-13A, this site has been strategically placed to increase the likelihood of detecting an unusual release of tritium. Historical results indicate that tritium concentrations are seldom detected at this site.

Although trees have an unavoidable influence in the region surrounding this sampler, this station has direct line of sight vision with the Building 75 complex.

ENV-13D

The ENV-13D monitoring station is representative of tritium concentrations at the northern edge of the LBNL property that borders a residential neighborhood of Berkeley. ENV-13D is situated northwest of the NTLF in line with the ENV-LHS site. This site is approximately five times further from the source than the ENV-LHS site.

This site has been strategically placed in one of the two predominant downwind directions from the NTLF, specifically the direction most commonly occurring during nighttime periods and storm events. ENV-13D is one of three stations in this direction from the NTLF, providing data on the rate of decrease in tritium levels in the second most frequent direction that the wind blows. This site has a minimal influence from trees and buildings.

ENV-69

The ENV-69 monitoring station has been placed to measure tritium concentrations at the northeastern edge of the LBNL property in the immediate vicinity of the NTLF facility. North of this station is an extensive region of undeveloped University of California wildland and ecological study area land.

This site has been placed in the most predominant downwind direction from the NTLF, specifically the direction that the wind most frequently blows during daytime periods. This station is the nearest sampling site to the source in this direction.

This station is located on the roof of a long, low building that is located in a naturally-occurring bowl. This combination minimizes the normal disruptions to airflow patterns caused by buildings. From a practical aspect, this is the best option for siting a station in this section of the LBNL property.

ENV-75EG

The purpose of Station ENV-75EG is to measure tritium concentrations in the vicinity of the Building 75 hillside stack within the eucalyptus grove. It is the nearest station to the stack.

Historical analyses of meteorological conditions and tritium dose assessments show that this site is in one of the two predominant downwind directions from the NTLF, specifically the direction most commonly occurring during nighttime periods and storm events. This is the first of three stations in this direction from the NTLF, providing an indication of how quickly tritium levels decrease with distance.

This station is heavily influenced by the surrounding grove of eucalyptus trees and would not adhere to most common criteria for siting ambient stations.

ENV-85

This site is located east of the NTLF near Building 85. This site is representative of tritium concentrations at the eastern edge of the LBNL property. Beyond this station is an extensive region of undeveloped University of California wildland and ecological study area land.

Historical analyses of meteorological conditions and tritium dose assessments show that this site is strategically placed in one of the two predominant downwind directions from the NTLF, specifically the most predominant direction and the direction that occurs mostly during daytime periods. Combining the results from this station with those from ENV-69 provides valuable data on the rate of decrease in tritium levels in this direction.

This station is also sited to include minor contributions from activities at the Hazardous Waste Handling Facility.

The influence of the terrain on flow patterns at the station is greater than any influence from trees or buildings. The chosen site minimizes the influence of all three factors in this area.

ENV-LHS

The ENV-LHS monitor is located at the Lawrence Hall of Science, on property owned by the University of California. Past annual NESHAPs compliance assessments have shown this site as the location of the maximally exposed individual (MEI). Although there is an influence from the nearby eucalyptus grove and the LHS building, these influences are offset by the need to collect data at a location representative of the MEI.

This site has been placed in the most commonly occurring direction for winds during nighttime hours and during storm events. This site, used in conjunction with Stations ENV-75EG and ENV-13D, provides information on the rate of decrease of tritium concentrations in the northwest wind sector.

4.2 Proposed Sites

A detailed analysis of projected tritium concentrations has been performed using the CALPUFF modeling system to identify locations that would best satisfy the practical considerations of sampling at a distance where detectable levels of tritium are predicted in directions from the NTLF where winds are less frequently expected to blow.

ENV-31

ENV-31 will be located in the southeast wind direction from the NTLF. This site will provide monitoring coverage for a wind sector that is currently without a sampling site. The absence of trees and buildings enhance the quality of this sampling location.

ENV-44

Station ENV-44 is located at the onsite 20-meter weather tower. This site would provide monitoring coverage for a sector that is currently without a sampling site. This monitor has been proposed for the detection of tritium should the winds blow in this infrequent wind sector during the time of a release. This proposed site is the nearest feasible to the NTLF in this wind sector.

ENV-77

Station ENV-77 will allow for the collection of monitoring data in the southern wind direction, which was previously unmonitored. This monitor will detect tritium should the winds blow in this infrequent wind sector during the time of a release. This monitor will be placed near Building 77, directly downhill from the Building 75 rooftop stack in the southern direction.

ENV-78

Station ENV-78 will allow for the collection of monitoring data in a wind sector that previously was unmonitored. This monitor will detect tritium should the winds blow in this infrequent wind sector during the time of a release. This monitor will be placed on the roof of Building 78, clearly visible from the Building 75 rooftop stack.

ENV-AR

This proposed station would be located at the East Bay Municipal Utility District's Amito Reservoir. The reason for selecting this site was to meet the needs of a supplemental monitoring request from EPA by providing sampling data in the HRS target ring distance category of 1 to 2 miles. The site experiences similar meteorological conditions in terms of temperatures, humidity, winds, and precipitation as LBNL. It also has a similar elevation as the NTLF. This site is expected to be representative of background tritium concentrations for the region.

ENV-MSRI

The ENV-MSRI is situated about halfway between ENV-LHS and ENV-SSL on the grounds of the University of California. The ENV-MSRI monitor will be located near the Mathematical Sciences Research Institute building. This site will provide monitoring coverage for a wind sector that is currently without a sampling site. This site is the nearest feasible location to the NTLF in this wind sector because of the presence of essential support services.

The MSRI building will have some influence on airflow near the sampler. However, building impact will be minimized because the building is not between the station and the NTLF. In addition, the inlet probe will be located as far away from the building as is feasible. Although there are no trees immediately adjacent to the sampler, the surrounding hillside has scattered clusters of trees.

ENV-SSL

The ENV-SSL monitor will be located at the satellite dish pad of the University of California's Silver Space Science Laboratory. This site will provide monitoring coverage for a wind sector that is currently without a sampling site. Although there are trees on the surrounding hillsides, the exposure of the pad is good for sampling. This site is the nearest feasible location to the NTLF for sampling in this wind sector because of the presence of essential support services.

ENV-UCBG

Station ENV-UCBG has been proposed in response to a request made by EPA to provide supplemental monitoring data in the HRS target ring distance category of 0.5 to 1 miles. This monitor will be located at the University of California Botanical Gardens.

This site has been strategically proposed in the most predominant downwind directions from the NTLF. The wind most frequently blows in this direction during daytime periods. Combining the results from this station with those from ENV-69 and ENV-85

provides additional valuable data on rates of decrease in tritium levels in this direction. The chosen site has excellent exposure to any winds coming from the direction of the NTLF.

4.3 Representation of 16 Standard Wind Sectors

The existing and proposed monitoring stations are included on an LBNL site map (Figure 6), which includes the 16 compass sectors centered on the NTLF. Observed wind patterns at the LBNL site indicate that the wind blows very rarely in some directions (e.g., from the N, NNE, NE and ENE wind sectors). The existing sampling stations are located in 7 of the 16 standard wind sectors. The proposed monitoring stations have been sited to cover the remaining wind sectors. Ten of the 16 sectors contain at least one monitoring station, while 4 stations (ENV-13A, ENV-LHS, ENV-SSL, and ENV44) border the remaining 6 sectors. In a practical sense, all wind directions are represented and the placement of stations is such that a higher than average release from the NTLF is likely to be detected under all meteorological conditions.

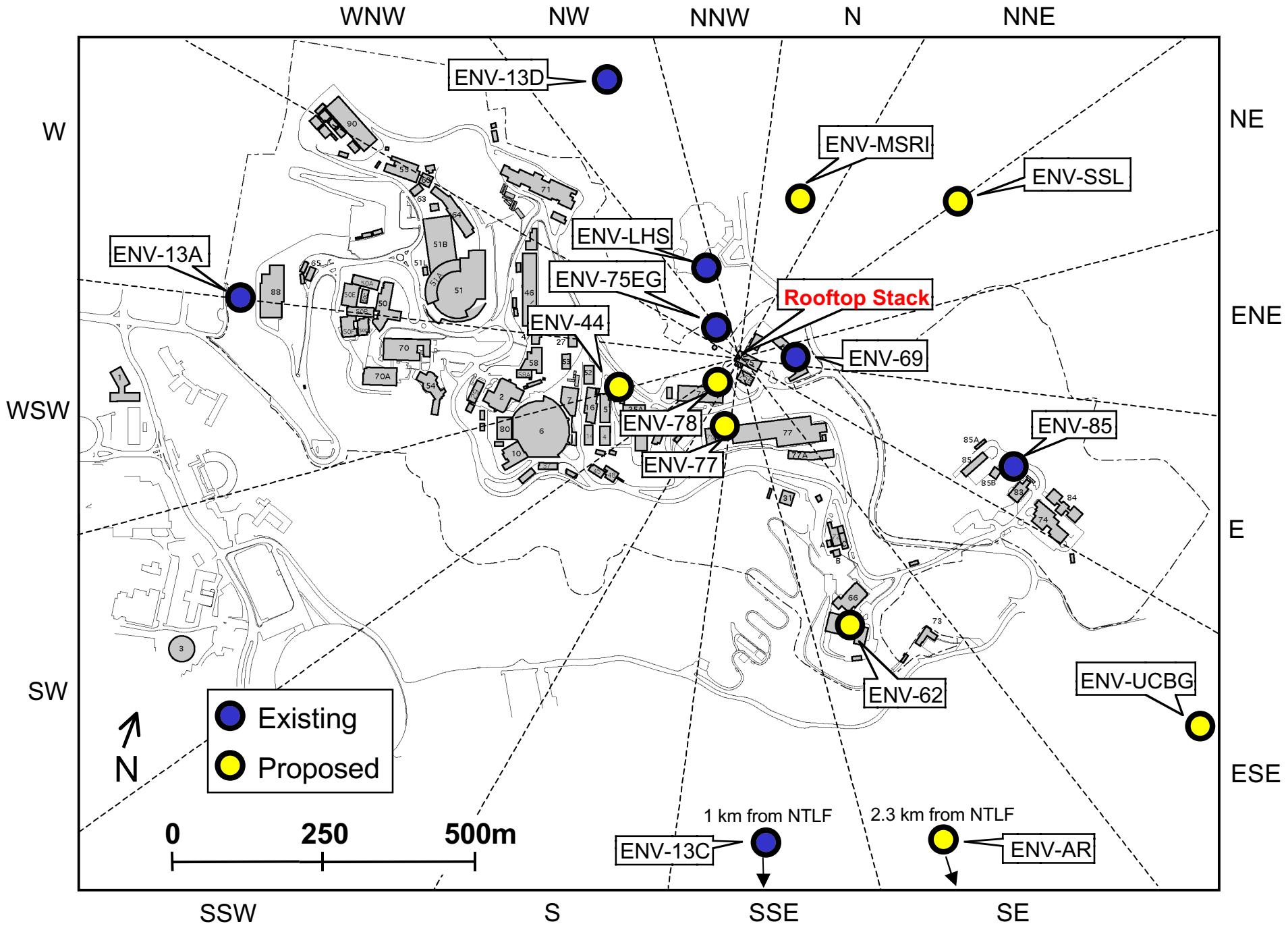


Figure 6. Existing and proposed monitoring locations with respect to the 16 standard wind sectors.

5.0 REFERENCE CONCENTRATIONS AND DOSES FOR HTO IN AIR

This section discusses how the air concentrations of HTO estimated in Figures 2 through 5 can be put into perspective with NESHAP dose limit of 10 mrem/yr and the DOE guidance for siting air monitors of 1 mrem/yr. Reference air concentrations and associated effective whole body doses based on exposure to HTO from inhalation and skin absorption are given in Tables 4a and 4b. Food ingestion of HTO is not considered, as this exposure route would be relevant only for locations where food crops are produced for local consumption.

The dose estimates in Tables 4a and 4b assume two conditions: (1) that the radiological decay of tritium incorporated into cellular material is no more effective than x-rays (quality factor equal to 1), and (2) an elevated quality factor ranging from 1.0 to 5.0, with a mode of 2.0 (Thomas and Hoffman, 2000; Straume, 2000; Straume, 1998; Straume, 1993).

Reference air concentrations and associated whole body doses for a male onsite worker exposed to various air concentrations of HTO are given in Table 4a. It is assumed that the male worker will be exposed for 9 hours per day, 5 days per week, for 52 weeks, minus vacation, holidays, and sick-leave for a total of 2043 hours per year. An elevated breathing rate ranging from 24 to 43 m^3/d is used for this assessment (EPA, 1997).

Reference air concentrations and associated whole body doses for a male offsite resident are presented in Table 4b. It is assumed that the offsite resident will be exposed for 24 hours per day, 7 days per week, for 50 weeks for a total of 8,400 hours. An average daily breathing rate ranging from 13 to 23 m^3/d has been assumed for the offsite resident (EPA, 1997). The largest air concentration presented in Table 4b (2,300 pCi/m³) is equivalent to an upper bound whole body dose of 10 mrem in a year, assuming the quality factor adjustment.

The maximum annual dose estimated for all plausible onsite and offsite air concentrations resulting from a release of 30 Ci/y HTO is less than 0.09 mrem/y (for an offsite air

concentration of 20 pCi/m³). This dose would add less than one tenth of 1% to natural background radiation, which is approximately 100 mrem per year, excluding the dose from indoor radon (NCRP, 1987). It is also less than 1% of the NESHAPs limit of 10 mrem per year. The annual doses for all air concentrations seen in Figures 2 through 5 are far below quantities considered to be of concern by State and Federal agencies responsible for the protection of public health and are far below the NCRP negligible dose level of 1 mrem per year (NCRP, 1993).

The health risk associated with prolonged exposure at these levels would be so low as to be indistinguishable from zero. Tables 4a and 4b clearly demonstrate the small levels of exposure and dose that would be associated with present day releases of tritium from the NTLF. Present day environmental standards for tritium would not be exceeded even if the NTLF were to release quantities consistent with its operations of more than 10 years in the past.

Table 4a. Annual whole body doses^a for a male onsite worker^b exposed to various reference air concentrations of HTO.

Reference Air Concentration (pCi/m ³) ^c	Dose (mrem/yr) ^c without quality factor adj. ^d			Dose (mrem/yr) ^c with quality factor adj. ^e			Notes	
	95% uncertainty range			95% uncertainty range				
	lower	central	upper	lower	central	upper		
6200	0.81	1.6	3.0	1.5	4.0	10	Air concentration equivalent to an upper bound whole body dose of 10 mrem in a year via the inhalation and skin absorption pathways.	
620	0.081	0.16	0.30	0.15	0.40	1.0	Air concentration equivalent to an upper bound whole body dose of 1 mrem in a year.	
50	0.0065	0.013	0.025	0.012	0.032	0.081	EPA screening value for Hazard Ranking Scoring of sites for potential designation on the National Priorities List (this value is not applicable to operating permitted facilities).	
20	0.0026	0.0050	0.0098	0.0048	0.013	0.032	The highest annual average isoconcentration line predicted either by mathematical models or wind tunnel studies for an annual release of 30 Ci.	
10	0.0013	0.0025	0.0049	0.0024	0.0064	0.016	The highest offsite annual average isoconcentration line predicted either by mathematical models or wind tunnel studies for an annual release of 30 Ci.	
5	0.00065	0.0013	0.0025	0.0012	0.0032	0.0081	The minimum level of analytical detection for tritium (2 to 5 pCi/m ³).	
2	0.00026	0.00050	0.00098	0.00048	0.0013	0.0032	The minimum level of analytical detection for tritium (2 to 5 pCi/m ³).	
1	0.00013	0.00025	0.00049	0.00024	0.00064	0.0016	2 to 5 times below limits of analytical detection for silica gel ambient air monitors.	
0.1	0.000013	0.000025	0.000049	0.000024	0.000064	0.00016	20 to 50 times below limits of analytical detection for silica gel ambient air monitors.	

^a All doses based on exposure due to the inhalation and skin absorption pathways.

^b It is assumed that the onsite worker will potentially be exposed for 9 hours per day, 5 days per week, for 52 weeks (2,340 hours/year), minus vacation, holidays and sick-leave (approximately 33 days/year). Therefore, it is assumed that the onsite individual is exposed 2043 hours per year. An elevated breathing rate ranging from 24 to 43 m³/d has been assumed for the worker (EPA, 1997).

^c To convert mrem to Sv, multiply by 10⁻⁵. To convert pCi/m³ to Bq/m³, multiply by 0.037.

^d Quality factor for tritium is assumed to 1.0.

^e Quality factor for tritium is assumed to be a triangular distribution ranging from 1.0 to 5.0, with a mode of 2.0 (Thomas and Hoffman, 2000).

Table 4b. Annual whole body doses^a for a male offsite resident^b exposed to various reference air concentrations of HTO.

Reference Air Concentration (pCi/m ³) ^c	Dose (mrem/yr ^c) without quality factor adj. ^d			Dose (mrem/yr ^c) with quality factor adj. ^e			Notes	
	95% uncertainty range			95% uncertainty range				
	lower	central	upper	lower	central	upper		
2300	0.74	1.5	3.1	1.5	3.8	10	Air concentration equivalent to an upper bound whole body dose of 10 mrem in a year via the inhalation and skin absorption pathways.	
230	0.074	0.15	0.31	0.15	0.38	1.0	Air concentration equivalent to an upper bound whole body dose of 1 mrem in a year.	
50	0.016	0.033	0.067	0.032	0.084	0.22	EPA screening value for Hazard Ranking Scoring of sites for potential designation on the National Priorities List (this value is not applicable to operating permitted facilities).	
20	0.0064	0.013	0.027	0.013	0.033	0.087	The highest annual average isoconcentration line predicted either by mathematical models or wind tunnel studies for an annual release of 30 Ci.	
10	0.0032	0.0065	0.013	0.0064	0.017	0.043	The highest offsite annual average isoconcentration line predicted either by mathematical models or wind tunnel studies for an annual release of 30 Ci.	
5	0.0016	0.0033	0.0067	0.0032	0.0084	0.022	The minimum level of analytical detection for tritium (2 to 5 pCi/m ³).	
2	0.00064	0.0013	0.0027	0.0013	0.0033	0.0087	The minimum level of analytical detection for tritium (2 to 5 pCi/m ³).	
1	0.00032	0.00065	0.0013	0.00064	0.0017	0.0043	2 to 5 times below limits of analytical detection for tritium.	
0.1	0.000032	0.000065	0.00013	0.000064	0.00017	0.00043	20 to 50 times below limits of analytical detection for tritium.	

^a All doses based on exposure due to the inhalation and skin absorption pathways.

^b It is assumed that the offsite resident will potentially be exposed for 24 hours per day, 7 days per week, for 50 weeks. A breathing rate ranging from 13 to 23 m³/d has been assumed for the resident (EPA, 1997).

^c To convert mrem to Sv, multiply by 10⁻⁵. To convert pCi/m³ to Bq/m³, multiply by 0.037.

^d Quality factor for tritium is assumed to be 1.0.

^e Quality factor for tritium is assumed to be a triangular distribution ranging from 1.0 to 5.0, with a mode of 2.0 (Thomas and Hoffman, 2000).

6.0 CONCLUSIONS

The detailed technical analysis discussed in this report defines a set of criteria used to review the current network of 7 ambient air monitoring stations and to justify the placement of 8 additional monitors.

The current ambient air monitoring network of 7 monitoring stations meet all criteria for monitoring tritium at sites operated for DOE. Although there are no regulatory or dose-based requirements for expanding the monitoring network at LBNL, the expansion to 15 stations is proposed to be responsive to recommendations made by IFEU to ensure that elevated short-term releases of tritium from the NTLF will be detected by air monitors placed in sectors of low wind frequency (Franke and Greenhouse, 2000; Franke and Greenhouse; 2001).

These criteria include consideration of the location of nearby population centers (both onsite and offsite), the placement of monitors with respect to the 16 standard wind sectors, and whether the site is located at a distance that would be associated with detectable concentrations of HTO in air. Other criteria include whether the site has access to dedicated electrical service, is easily accessible, and is reasonably secure.

Other sites were considered for the placement of monitoring stations and have been rejected due to the absence of available power sources, steep terrain, locations too far outside minimum level of detection, or the presence of safety hazards for those responsible for maintaining the equipment.

The annual averaged concentrations of HTO estimated using CALPUFF are comparable in magnitude to estimates produced from the UC Davis wind tunnel study and CAP88-PC computer code, although dispersion patterns differ. According to our estimates, the maximum onsite dose to a worker exposed during an average work year would be less than 0.032 mrem/y. The maximum dose to an offsite resident exposed 24 hours per day would be less than 0.087 mrem/y. All doses received as a result of operations at the

NTLF would be far below the applicable NESHAPs standard of 10 mrem/y. In addition, doses less than 1 mrem/y are considered negligible by the NCRP.

The recommended expansion of the ambient air network to 15 stations will have 7 stations located within 300 meters of the planned Building 75 rooftop stack. In addition, atmospheric modeling with CALPUFF indicates that 9 stations are located within the minimum detectable range for an annual release of 30 Ci. The maximum onsite and offsite air concentrations indicate exposures that are very small fractions of regulatory standards and are clearly below the NCRP negligible dose level of 1 mrem/y.

An additional benefit of the proposed expanded network is that the CALPUFF model can be calibrated to onsite and offsite monitoring results for the sectors and distances not directly covered by monitoring stations. These calibrated estimates can be used to increase the confidence in predicted concentrations of HTO in downwind directions and distances not explicitly represented by an ambient air station, or where concentrations are below limits of detection.

7.0 REFERENCES

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UNITS CONVERSION

This report refers to radiation quantities in the old (U.S.) units. The factors for converting these values into the new (SI) units are provided in Table 5.

Table 5. Units Conversion Table

To convert	To	Multiply by
Ci	Bq	3.7×10^{10}
pCi	Bq	0.037
mrem	Sv	1×10^{-5}

Appendix A

<u>FILE</u>	<u>PAGE</u>
CALPUFF Input File	A.2
CALPUFF Output File.....	A.26

CALPUFF - Tritium Release from Berkeley Lab

----- Run title (3 lines) -----

CALPUFF MODEL CONTROL FILE

INPUT GROUP: 0 -- Input and Output File Names

Default Name Type File Name

CALMET.DAT input ! METDAT =d:\p38069\calsurf\CALMETA.DAT !
or
ISCMET.DAT input * ISCDAT = *
or
PLMMET.DAT input * PLMDAT = *
or
PROFILE.DAT input * PRFDAT = *
SURFACE.DAT input * SFCDAT = *
RESTARTB.DAT input * RSTARTB= *

CALPUFF.LST output ! PUFLST =nsa.LST !
CONC.DAT output ! CONDAT =nsa.CON !
DFLX.DAT output ! DFDAT =nsa.DRY !
WFLX.DAT output ! WFDAT =nsa.WET !

VISB.DAT output * VISDAT = *
RESTARTE.DAT output * RSTARTE= *

Emission Files

PTEMARB.DAT input * PTDAT = *
VOLEM.DAT input * VOLDAT = *
BAEMARB.DAT input * ARDAT = *
LNEMARB.DAT input * LNDAT = *

Other Files

OZONE.DAT input * OZDAT = *
VD.DAT input * VDDAT = *
CHEM.DAT input * CHEMDAT= *
HILL.DAT input * HILDAT= *
HILLRCT.DAT input * RCTDAT= *
COASTLN.DAT input * CSTDAT= *
DEBUG.DAT output * DEBUG = *

All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
T = lower case ! LCFILES = F !
F = UPPER CASE

NOTE: (1) file/path names can be up to 70 characters in length

!END!

INPUT GROUP: 1 -- General run control parameters

Option to run all periods found
in the met. file(s) (METRUN) Default: 0 ! METRUN = 0 !

METRUN = 0 - Run period explicitly defined below
METRUN = 1 - Run all periods in met. file(s)

Starting date: Year (IBYR) -- No default ! IBYR = 1998 !
(used only if Month (IBMO) -- No default ! IBMO = 1 !
METRUN = 0) Day (IBDY) -- No default ! IBDY = 1 !
Hour (IBHR) -- No default ! IBHR = 0 !

Length of run (hours) (IRLG) -- No default ! IRLG = 4344 !

Number of chemical species (NSPEC)
Default: 5 ! NSPEC = 2 !

Number of chemical species
to be emitted (NSE) Default: 3 ! NSE = 2 !

Flag to stop run after
SETUP phase (ITEST) Default: 2 ! ITEST = 2 !
(Used to allow checking
of the model inputs, files, etc.)
ITEST = 1 - STOPS program after SETUP phase
ITEST = 2 - Continues with execution of program
after SETUP

Restart Configuration:

Control flag (MRESTART) Default: 0 ! MRESTART = 0 !

0 = Do not read or write a restart file
1 = Read a restart file at the beginning of
the run
2 = Write a restart file during run
3 = Read a restart file at beginning of run
and write a restart file during run

Number of periods in Restart
output cycle (NRESPD) Default: 0 ! NRESPD = 0 !

0 = File written only at last period
>0 = File updated every NRESPD periods

Meteorological Data Format (METFM)
Default: 1 ! METFM = 1 !

METFM = 1 - CALMET binary file (CALMET.MET)
METFM = 2 - ISC ASCII file (ISCMET.MET)
METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
surface parameters file (SURFACE.DAT)

Averaging Time (minutes) (AVET)
Default: 60.0 ! AVET = 60. !
PG sigma-y is adjusted by the equation
(AVET/60.0)**0.2

!END!

INPUT GROUP: 2 -- Technical options

Vertical distribution used in the
near field (MGAUSS) Default: 1 ! MGAUSS = 1 !
0 = uniform
1 = Gaussian

Terrain adjustment method
(MCTADJ) Default: 3 ! MCTADJ = 3 !
0 = no adjustment
1 = ISC-type of terrain adjustment
2 = simple, CALPUFF-type of terrain
adjustment
3 = partial plume path adjustment

Subgrid-scale complex terrain
flag (MCTSG) Default: 0 ! MCTSG = 0 !
0 = not modeled
1 = modeled

Near-field puffs modeled as
elongated 0 (MSLUG) Default: 0 ! MSLUG = 1 !
0 = no
1 = yes (slug model used)

Transitional plume rise modeled ?
(MTRANS) Default: 0 ! MTRANS = 1 !
0 = no (i.e., final rise only)
1 = yes (i.e., transitional rise computed)

Stack tip downwash? (MTIP) Default: 1 ! MTIP = 1 !
0 = no (i.e., no stack tip downwash)
1 = yes (i.e., use stack tip downwash)

Vertical wind shear modeled above
stack top? (MSHEAR) Default: 0 ! MSHEAR = 1 !
0 = no (i.e., vertical wind shear not modeled)
1 = yes (i.e., vertical wind shear modeled)

Puff splitting allowed? (MSPLIT) Default: 0 ! MSPLIT = 1 !
0 = no (i.e., puffs not split)
1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM) Default: 1 ! MCHEM = 0 !
0 = chemical transformation not
modeled
1 = transformation rates computed
internally (MESOPUFF II scheme)
2 = user-specified transformation
rates used
3 = transformation rates computed
internally (RIVAD/ARM3 scheme)

Wet removal modeled ? (MWET) Default: 1 ! MWET = 1 !
0 = no
1 = yes

Dry deposition modeled ? (MDRY) Default: 1 ! MDRY = 1 !
0 = no
1 = yes
(dry deposition method specified
for each species in Input Group 3)

Method used to compute dispersion coefficients (MDISP) Default: 3 ! MDISP = 2 !

1 = dispersion coefficients computed from measured values of turbulence, sigma v, sigma w
 2 = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (u*, w*, L, etc.)
 3 = PG dispersion coefficients for RURAL areas (computed using the ISCST multi-segment approximation) and MP coefficients in urban areas
 4 = same as 3 except PG coefficients computed using the MESOPUFF II eqns.
 5 = CTDM sigmas used for stable and neutral conditions. For unstable conditions, sigmas are computed as in MDISP = 3, described above. MDISP = 5 assumes that measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
 (Used only if MDISP = 1 or 5) Default: 3 ! MTURBVW = 3 !

1 = use sigma-v or sigma-theta measurements from PROFILE.DAT to compute sigma-y (valid for METFM = 1, 2, 3, 4)
 2 = use sigma-w measurements from PROFILE.DAT to compute sigma-z (valid for METFM = 1, 2, 3, 4)
 3 = use both sigma-(v/theta) and sigma-w from PROFILE.DAT to compute sigma-y and sigma-z (valid for METFM = 1, 2, 3, 4)
 4 = use sigma-theta measurements from PLMMET.DAT to compute sigma-y (valid only if METFM = 3)

Back-up method used to compute dispersion when measured turbulence data are missing (MDISP2) Default: 3 ! MDISP2 = 3 !
 (used only if MDISP = 1 or 5)

2 = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (u*, w*, L, etc.)
 3 = PG dispersion coefficients for RURAL areas (computed using the ISCST multi-segment approximation) and MP coefficients in urban areas
 4 = same as 3 except PG coefficients computed using the MESOPUFF II eqns.

PG sigma-y,z adj. for roughness? Default: 0 ! MROUGH = 0 !
 (MROUGH)
 0 = no
 1 = yes

Partial plume penetration of elevated inversion? Default: 1 ! MPARTL = 1 !
 (MPARTL)
 0 = no
 1 = yes

Strength of temperature inversion provided in PROFILE.DAT extended records? Default: 0 ! MTINV = 0 !
 (MTINV)
 0 = no (computed from measured/default gradients)
 1 = yes

PDF used for dispersion under convective conditions? Default: 0 ! MPDF = 0 !

(MPDF)
 0 = no
 1 = yes

Sub-Grid TIBL module used for shore line? Default: 0 ! MSGTIBL = 0 !

(MSGTIBL)
 0 = no
 1 = yes

Test options specified to see if they conform to regulatory values? (MREG) Default: 1 ! MREG = 0 !

0 = NO checks are made
 1 = Technical options must conform to USEPA values

METFM	1
AVET	60. (s)
MGAUSS	1
MCTADJ	3
MTRANS	1
MTIP	1
MCHEM	1 (if modeling SOx, NOx)
MWET	1
MDRY	1
MDISP	3
MROUGH	0
MPARTL	1
SYTDEP	550. (m)
MHETSZ	0

!END!

INPUT GROUP: 3a, 3b -- Species list

Subgroup (3a)

The following species are modeled:

! CSPEC = SO2 ! !END!
! CSPEC = NO2 ! !END!

SPECIES NAME (Limit: 12)	MODELED (0=NO, 1=YES)	EMITTED (0=NO, 1=YES)	Dry DEPOSITED (0=NO, 1=COMPUTED-GAS)	OUTPUT GROUP NUMBER (0=NONE, 1=1st)
CGRUP, Characters			2=COMPUTED-PARTICLE	2=2nd
CGRUP, in length)			3=USER-SPECIFIED)	3= etc.)
!	SO2 =	1,	1,	0 !
!	NO2 =	1.	1,	0 !

!END!

Subgroup (3b)

The following names are used for Species-Groups in which results for certain species are combined (added) prior to output. The CGRUP name will be used as the species name in output files. Use this feature to model specific particle-size distributions by treating each size-range as a separate species. Order must be consistent with 3(a) above.

INPUT GROUP: 4 -- Grid control parameters

METEOROLOGICAL grid:

No. X grid cells (NX)	No default	! NX = 41 !
No. Y grid cells (NY)	No default	! NY = 41 !
No. vertical layers (NZ)	No default	! NZ = 10 !
Grid spacing (DGRIDKM)	No default	! DGRIDKM = 0.25 !
	Units: km	
Cell face heights (ZFACE(nz+1))	No defaults	
	Units: m	
! ZFACE = 0., 20., 40., 80., 160., 300., 600., 1000., 1500., 2200.,		
3000. !		
Reference Coordinates of SOUTHWEST corner of grid cell(1, 1):		
X coordinate (XORIGKM)	No default	! XORIGKM = 561.435 !
Y coordinate (YORIGKM)	No default	! YORIGKM = 4187.335 !
	Units: km	
UTM zone (IUTMZN)	No default	! IUTMZN = 10 !
Reference coordinates of CENTER of the domain (used in the calculation of solar elevation angles)		
Latitude (deg.) (XLAT)	No default	! XLAT = 37.833 !
Longitude (deg.) (XLONG)	No default	! XLONG = 122.302 !
Time zone (XTZ) (PST=8, MST=7, CST=6, EST=5)	No default	! XTZ = 8.0 !

Computational grid:

The computational grid is identical to or a subset of the MET. grid. The lower left (LL) corner of the computational grid is at grid point (IBCOMP, JBCOMP) of the MET. grid. The upper right (UR) corner of the computational grid is at grid point (IECOMP, JECOMP) of the MET. grid. The grid spacing of the computational grid is the same as the MET. grid.

X index of LL corner (IBCOMP) (1 <= IBCOMP <= NX)	No default	! IBCOMP = 13 !
Y index of LL corner (JBCOMP) (1 <= JBCOMP <= NY)	No default	! JBCOMP = 13 !
X index of UR corner (IECOMP) (1 <= IECOMP <= NX)	No default	! IECOMP = 28 !
Y index of UR corner (JECOMP) (1 <= JECOMP <= NY)	No default	! JECOMP = 28 !

SAMPLING GRID (GRIDDED RECEPTORS):

The lower left (LL) corner of the sampling grid is at grid point (IBSAMP, JBSAMP) of the MET. grid. The upper right (UR) corner of the sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid. The sampling grid must be identical to or a subset of the computational grid. It may be a nested grid inside the computational grid. The grid spacing of the sampling grid is DGRIDKM/MESHDN.

Logical flag indicating if gridded receptors are used (LSAMP)	Default: T	! LSAMP = T !
(T=yes, F=no)		
X index of LL corner (IBSAMP) (IBCOMP <= IBSAMP <= IECOMP)	No default	! IBSAMP = 13 !
Y index of LL corner (JBSAMP) (JBCOMP <= JBSAMP <= JECOMP)	No default	! JBSAMP = 13 !
X index of UR corner (IESAMP) (IBCOMP <= IESAMP <= IECOMP)	No default	! IESAMP = 28 !
Y index of UR corner (JESAMP) (JBCOMP <= JESAMP <= JECOMP)	No default	! JESAMP = 28 !
Nesting factor of the sampling grid (MESHDN) (MESHDN is an integer >= 1)	Default: 1	! MESHDN = 3 !

!END!

INPUT GROUP: 5 -- Output Options

FILE	DEFAULT VALUE	VALUE THIS RUN
Concentrations (ICON)	1	! ICON = 1 !
Dry Fluxes (IDRY)	1	! IDRY = 1 !
Wet Fluxes (IWET)	1	! IWET = 1 !
Relative Humidity (IVIS) (relative humidity file is required for visibility analysis)	1	! IVIS = 0 !
Use data compression option in output file? (LCOMPRS)	Default: T	! LCOMPRS = T !

*

0 = Do not create file, 1 = create file

LINE PRINTER OUTPUT OPTIONS:

Print concentrations (ICPRT)	Default: 0	! ICPRT = 0 !
Print dry fluxes (IDPRT)	Default: 0	! IDPRT = 0 !
Print wet fluxes (IWPRT)	Default: 0	! IWPRT = 0 !
(0 = Do not print, 1 = Print)		
Concentration print interval (ICFRQ) in hours	Default: 1	! ICFRQ = 1 !
Dry flux print interval (IDFRQ) in hours	Default: 1	! IDFRQ = 1 !
Wet flux print interval (IWFRQ) in hours	Default: 1	! IWFRQ = 1 !
Units for Line Printer Output (IPRTU)	Default: 1	! IPRTU = 3 !
for Concentration	for Deposition	
1 = g/m**3	g/m**2/s	
2 = mg/m**3	mg/m**2/s	
3 = ug/m**3	ug/m**2/s	
4 = ng/m**3	ng/m**2/s	
5 = Odour Units		
Messages tracking progress of run written to the screen ? (IMESG) -- 0=no, 1=yes	Default: 1	! IMESG = 1 !

SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

----- CONCENTRATIONS -----			----- DRY FLUXES -----		
----- WET FLUXES -----					
SPECIES					
/GROUP	PRINTED ?	SAVED ON DISK ?	PRINTED ?	SAVED ON DISK ?	
PRINTED ?	SAVED ON DISK ?				
!	SO2 = 1,	1,	0,	1,	
0,	1 !				
!	NO2 = 1,	1,	0,	1,	
0,	1 !				

OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

Logical for debug output (LDEBUG)	Default: F	! LDEBUG = F !
Number of puffs to track (NPFDEB)	Default: 1	! NPFDEB = 1 !
Met. period to start output (NN1)	Default: 1	! NN1 = 1 !
Met. period to end output (NN2)	Default: 10	! NN2 = 10 !

!END!

INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs

Subgroup (6a)

Number of terrain features (NHILL)	Default: 0	! NHILL = 0 !
Number of special complex terrain receptors (NCTREC)	Default: 0	! NCTREC = 0 !
Terrain and CTSG Receptor data for CTSG hills input in CTDM format ? (MHILL)	No Default	! MHILL = 0 !
1 = Hill and Receptor data created by CTDM processors & read from HILL.DAT and HILLRCT.DAT files		
2 = Hill data created by OPTHILL & input below in Subgroup (6b); Receptor data in Subgroup (6c)		
Factor to convert horizontal dimensions to meters (MHILL=1)	Default: 1.0	! XHILL2M = 1. !
Factor to convert vertical dimensions to meters (MHILL=1)	Default: 1.0	! ZHILL2M = 1. !
X-origin of CTDM system relative to CALPUFF coordinate system, in Kilometers (MHILL=1)	No Default	! XCTDMKM = 0.0E00 !
Y-origin of CTDM system relative to CALPUFF coordinate system, in Kilometers (MHILL=1)	No Default	! YCTDMKM = 0.0E00 !

! END !

Subgroup (6b)

1 **
HILL information

HILL SCALE 2 NO. (m)	XC AMAX1 (km)	YC AMAX2 (km)	THETAH (deg.)	ZGRID (m)	RELIEF (m)	EXPO 1 (m)	EXPO 2 (m)	SCALE 1 (m)
-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----

Subgroup (6c)

COMPLEX TERRAIN RECEPTOR INFORMATION

XRCT (km)	YRCT (km)	ZRCT (m)	XHH
-----	-----	-----	-----

1

Description of Complex Terrain Variables:

XC, YC = Coordinates of center of hill
THETAH = Orientation of major axis of hill (clockwise from North)
ZGRID = Height of the 0 of the grid above mean sea level
RELIEF = Height of the crest of the hill above the grid elevation
EXPO 1 = Hill-shape exponent for the major axis
EXPO 2 = Hill-shape exponent for the major axis
SCALE 1 = Horizontal length scale along the major axis
SCALE 2 = Horizontal length scale along the minor axis
AMAX = Maximum allowed axis length for the major axis
BMAX = Maximum allowed axis length for the major axis

XRCT, YRCT = Coordinates of the complex terrain receptors
ZRCT = Height of the ground (MSL) at the complex terrain Receptor
XHH = Hill number associated with each complex terrain receptor
(NOTE: MUST BE ENTERED AS A REAL NUMBER)

**

NOTE: DATA for each hill and CTSG receptor are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases

SPECIES HENRY'S LAW COEFFICIENT NAME (dimensionless)	DIFFUSIVITY (cm**2/s)	ALPHA STAR	REACTIVITY	MESOPHYLL RESISTANCE (s/cm)
! SO2 = 0.04 !	0.1659,	1.,	8.,	5.,
! NO2 = 0.04 !	0.1656,	1.,	8.,	5.,

!END!

INPUT GROUP: 8 -- Size parameters for dry deposition of particles

For SINGLE SPECIES, the mean and standard deviation are used to compute a deposition velocity for NINT (see group 9) size-ranges, and these are then averaged to obtain a mean deposition velocity.

For GROUPED SPECIES, the size distribution should be explicitly specified (by the 'species' in the group), and the standard deviation for each should be entered as 0. The model will then use the deposition velocity for the stated mean diameter.

SPECIES NAME	GEOMETRIC MASS MEAN DIAMETER (microns)	GEOMETRIC STANDARD DEVIATION (microns)
! SO2 = ! NO2 =	0.10, 0.10,	0.01 ! 0.01 !

!END!

INPUT GROUP: 9 -- Miscellaneous dry deposition parameters

Reference cuticle resistance (RCUTR) (s/cm) ! RCUTR = 30. !
Reference ground resistance (RGR) (s/cm) ! RGR = 5. !
Reference pollutant reactivity (REACTR) ! REACTR = 8. !

Number of particle-size intervals used to evaluate effective particle deposition velocity (NINT) Default: 9 ! NINT = 9 !

Vegetation state in unirrigated areas (IVEG) ! IVEG = 1 !
IVEG=1 for active and unstressed vegetation
IVEG=2 for active and stressed vegetation
IVEG=3 for inactive vegetation

!END!

INPUT GROUP: 10 -- Wet Deposition Parameters

Scavenging Coefficient -- Units: (sec)**(-1)

Pollutant	Liquid Precip.	Frozen Precip.
! SO2 =	3.0E-05,	5.0E-06 !
! NO2 =	3.0E-05,	5.0E-06 !

!END!

INPUT GROUP: 11 -- Chemistry Parameters

Ozone data input option (MOZ) Default: 1 ! MOZ = 0 !
(Used only if MCHEM = 1 or 3)

0 = use a constant background ozone value
1 = read hourly ozone concentrations from
the OZONE.DAT data file

Background ozone concentration
(BCKO3) in ppb Default: 80. ! BCKO3 = 40. !
(Used only if MCHEM = 1 or 3 and
MOZ = 0 or (MOZ = 1 and all hourly
O3 data missing))

Background ammonia concentration
(BCKNH3) in ppb Default: 10. ! BCKNH3 = 10. !

Nighttime SO2 loss rate (RNITE1)
in percent/hour Default: 0.2 ! RNITE1 = 0.2 !

Nighttime NOx loss rate (RNITE2)
in percent/hour Default: 2.0 ! RNITE2 = 2. !

Nighttime HNO3 formation rate (RNITE3)
in percent/hour Default: 2.0 ! RNITE3 = 2. !

!END!

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters

Horizontal size of puff (m) beyond which
time-dependent dispersion equations (Heffter)
are used to determine sigma-y and
sigma-z (SYTDEP) Default: 550. ! SYTDEP = 5.5E02 !

Switch for using Heffter equation for sigma z
as above (0 = Not use Heffter; 1 = use Heffter
(MHFTSZ) Default: 0 ! MHFTSZ = 0 !

Stability class used to determine plume growth rates for puffs above the boundary layer (JSUP) Default: 5 ! JSUP = 5 !

Vertical dispersion constant for stable conditions (k1 in Eqn. 2.7-3) (CONK1) Default: 0.01 ! CONK1 = 0.01 !

Vertical dispersion constant for neutral/unstable conditions (k2 in Eqn. 2.7-4) (CONK2) Default: 0.1 ! CONK2 = 0.1 !

Factor for determining Transition-point from Schulman-Scire to Huber-Snyder Building Downwash scheme (SS used for Hs < Hb + TBD * HL) (TBD) Default: 0.5 ! TBD = 0.5 !

- TBD < 0 ==> always use Huber-Snyder
- TBD = 1.5 ==> always use Schulman-Scire
- TBD = 0.5 ==> ISC Transition-point

Range of land use categories for which urban dispersion is assumed (IURB1, IURB2) Default: 10 ! IURB1 = 10 !
19 ! IURB2 = 19 !

Site characterization parameters for single-point Met data files ----- (needed for METFM = 2,3,4)

Land use category for modeling domain (ILANDUIN) Default: 20 ! ILANDUIN = 20 !

Roughness length (m) for modeling domain (ZOIN) Default: 0.25 ! ZOIN = 0.25 !

Leaf area index for modeling domain (XLAIIN) Default: 3.0 ! XLAIIN = 3. !

Elevation above sea level (m) (ELEVIN) Default: 0.0 ! ELEVIN = 0. !

Latitude (degrees) for met location (XLATIN) Default: -999. ! XLATIN = 0. !

Longitude (degrees) for met location (XLONIN) Default: -999. ! XLONIN = 0. !

Specialized information for interpreting single-point Met data files -----

Anemometer height (m) (Used only if METFM = 2,3) (ANEMHT) Default: 10. ! ANEMHT = 10. !

Form of lateral turbulence data in PROFILE.DAT file (Used only if METFM = 4 or MTURBVW = 1 or 3) (ISIGMAV) Default: 1 ! ISIGMAV = 1 !

- 0 = read sigma-theta
- 1 = read sigma-v

Choice of mixing heights (Used only if METFM = 4) (IMIXCTDM) Default: 0 ! IMIXCTDM = 0 !

- 0 = read PREDICTED mixing heights
- 1 = read OBSERVED mixing heights

Maximum length of a slug (met. grid units) (XMXLEN) Default: 1.0 ! XMXLEN = 1. !

Maximum travel distance of a puff/slug (in grid units) during one sampling step
 (XSAMLEN) Default: 1.0 ! XSAMLEN = 1. !

Maximum Number of slugs/puffs release from one source during one time step
 (MXNEW) Default: 99 ! MXNEW = 99 !

Maximum Number of sampling steps for one puff/slug during one time step
 (MXSAM) Default: 99 ! MXSAM = 99 !

Number of iterations used when computing the transport wind for a sampling step that includes gradual rise (for CALMET and PROFILE winds)
 (NCOUNT) Default: 2 ! NCOUNT = 2 !

Minimum sigma y for a new puff/slug (m)
 (SYMIN) Default: 1.0 ! SYMIN = 1. !

Minimum sigma z for a new puff/slug (m)
 (SZMIN) Default: 1.0 ! SZMIN = 1. !

Default minimum turbulence velocities sigma-v and sigma-w for each stability class (m/s)
 (SVMIN(6) and SWMIN(6)) Default SVMIN : .50, .50, .50, .50, .50, .50
 Default SWMIN : .20, .12, .08, .06, .03, .016

Stability Class :	A	B	C	D	E	F
	---	---	---	---	---	---

! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500,
 0.500!
 ! SWMIN = 0.200, 0.120, 0.080, 0.060, 0.030,
 0.016!

Divergence criterion for dw/dz across puff used to initiate adjustment for horizontal convergence (1/s)
 Partial adjustment starts at CDIV(1), and full adjustment is reached at CDIV(2)
 (CDIV(2)) Default: 0.0,0.0 ! CDIV = 0.0, 0.0 !

Minimum wind speed (m/s) allowed for non-calm conditions. Also used as minimum speed returned when using power-law extrapolation toward surface
 (WSCALM) Default: 0.5 ! WSCALM = 0.5 !

Maximum mixing height (m)
 (XMAXZI) Default: 3000. ! XMAXZI = 3000. !

Minimum mixing height (m)
 (XMINZI) Default: 50. ! XMINZI = 20. !

Default wind speed classes --
 5 upper bounds (m/s) are entered;
 the 6th class has no upper limit
 (WSCAT(5)) Default :
 ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8 (10.8+)

Wind Speed Class :	1	2	3	4	5	6
	---	---	---	---	---	---

! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80 !

Default wind speed profile power-law exponents for stabilities 1-6
 (PLX0(6))

Default	:	ISC RURAL values
ISC RURAL	:	.07, .07, .10, .15, .35, .55
ISC URBAN	:	.15, .15, .20, .25, .30, .30

Stability Class :	A	B	C	D	E	F
	---	---	---	---	---	---
!	PLX0	=	0.07, 0.07, 0.10, 0.15, 0.35, 0.55 !			

Default potential temperature gradient for stable classes E, F (degK/m)
 (PTG0(2))

Default:	0.020, 0.035
!	PTG0 = 0.020, 0.035 !

Default plume path coefficients for each stability class (used when option for partial plume height terrain adjustment is selected -- MCTADJ=3)
 (PPC(6))

Stability Class :	A	B	C	D	E	F
Default PPC :	.50, .50, .50, .50, .35, .35					
	---	---	---	---	---	---
!	PPC	=	0.50, 0.50, 0.50, 0.50, 0.35, 0.35 !			

Slug-to-puff transition criterion factor equal to sigma-y/length of slug
 (SL2PF)

Default:	10.
!	SL2PF = 10. !

Puff-splitting control variables -----

Number of puffs that result every time a puff is split - nsplit=2 means that 1 puff splits into 2
 (NSPLIT)

Default:	3
!	NSPLIT = 3 !

Time(s) of a day when split puffs are eligible to be split once again; this is typically set once per day, around sunset before nocturnal shear develops.
 24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
 0=do not re-split 1=eligible for re-split
 (IRESPLIT(24))

Default:	Hour 17 = 1
!	IRESPLIT = 0,0 !

Split is allowed only if last hour's mixing height (m) exceeds a minimum value
 (ZISPLIT)

Default:	100.
!	ZISPLIT = 100. !

Split is allowed only if ratio of last hour's mixing ht to the maximum mixing ht experienced by the puff is less than a maximum value (this postpones a split until a nocturnal layer develops)
 (ROLDMAX)

Default:	0.25
!	ROLDMAX = 0.25 !

Integration control variables -----

Fractional convergence criterion for numerical SLUG sampling integration
 (EPSSLUG)

Default:	1.0e-04
!	EPSSLUG = 1.0E-04 !

Fractional convergence criterion for numerical AREA source integration
 (EPSAREA)

Default:	1.0e-06
!	EPSAREA = 1.0E-06 !

!END!

INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters

Subgroup (13a)

Number of point sources with
parameters provided below (NPT1) No default ! NPT1 = 1 !

Units used for point source
emissions below (IPTU) Default: 1 ! IPTU = 1 !

1 = g/s
2 = kg/hr
3 = lb/hr
4 = tons/yr
5 = Odour Unit * m**3/s (vol. flux of odour compound)
6 = Odour Unit * m**3/min

Number of source-species
combinations with variable
emissions scaling factors
provided below in (13d) (NSPT1) Default: 0 ! NSPT1 = 0 !

Number of point sources with
variable emission parameters
provided in external file (NPT2) No default ! NPT2 = 0 !

(If NPT2 > 0, these point
source emissions are read from
the file: PTEMARB.DAT)

!END!

Subgroup (13b)

a
POINT SOURCE: CONSTANT DATA

b
c
Source X UTM Y UTM Stack Base Stack Exit Exit Bldg.
Emission No. Coordinate Coordinate Height Elevation Diameter Vel. Temp. Dwash
Rates
(km) (km) (m) (m) (m) (m/s) (deg. K)

--
1 ! SRCNAM = P1 !
1 ! X = 566.481, 4192.316, 9.1, 298.7, .57, 11.9, 293.15,
1.0, 1.0E00 !
1 ! FMFAC = 1.0 ! !END!

a

Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.

b

0. = No building downwash modeled, 1. = downwash modeled
NOTE: must be entered as a REAL number (i.e., with decimal point)

C

An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by IPTU (e.g. 1 for g/s).

Subgroup (13c)

Source

No. Effective building width and height (in meters) every 10 degrees

```
1      ! SRCNAM   =    P1 !
1      ! HEIGHT   =    3.80,    3.80,    3.80,    3.80,    3.80,    3.80,
1                                4.70,    4.70,    4.70,    3.80,    3.80,    4.70,
1                                4.70,    4.70,    4.70,    3.80,    3.80,    3.80,
1                                3.80,    3.80,    3.80,    3.80,    3.80,    3.80,
1                                4.70,    4.70,    4.70,    4.70,    4.70,    4.70,
1                                4.70,    4.70,    4.70,    3.80,    3.80,    3.80!
```

```

1      ! WIDTH   =    22.36,  23.50,  25.75,  27.00,  27.75,  27.50,
          26.50,  24.50,  22.00,  18.50,  20.75,  24.25,
          26.25,  27.25,  27.75,  27.88,  26.88,  25.00,
          22.36,  23.50,  25.75,  27.25,  27.75,  27.50,
          26.50,  24.75,  22.00,  18.50,  21.50,  24.00,
          26.00,  27.25,  28.00,  28.00,  26.88,  25.00!

```

!END!

a

Each pair of width and height values is treated as a separate input subgroup and therefore must end with an input group terminator.

Subgroup (13d)

POINT SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission rates given in 13b. Factors entered multiply the rates in 13b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

a
Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.

INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters

Subgroup (14a)

Number of polygon area sources with
parameters specified below (NAR1) No default ! NAR1 = 0 !

Units used for area source
emissions below (IARU) Default: 1 ! IARU = 1 !
1 = g/m**2/s
2 = kg/m**2/hr
3 = lb/m**2/hr
4 = tons/m**2/yr
5 = Odour Unit * m/s (vol. flux/m**2 of odour compound)
6 = Odour Unit * m/min

Number of source-species
combinations with variable
emissions scaling factors
provided below in (14d) (NSAR1) Default: 0 ! NSAR1 = 0 !

Number of buoyant polygon area sources
with variable location and emission
parameters (NAR2) No default ! NAR2 = 0 !
(If NAR2 > 0, ALL parameter data for
these sources are read from the file: BAEMARB.DAT)

!END!

Subgroup (14b)

a
AREA SOURCE: CONSTANT DATA

Source No.	Effect. Height (m)	Base Elevation (m)	Initial Sigma z (m)	Emission Rates
-----	-----	-----	-----	-----

a
Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.

b
An emission rate must be entered for every pollutant modeled.
Enter emission rate of zero for secondary pollutants that are
modeled, but not emitted. Units are specified by IARU
(e.g. 1 for g/m**2/s).

Subgroup (14c)

COORDINATES (UTM-km) FOR EACH VERTEX(4) OF EACH POLYGON

Source **No.** Ordered list of X followed by list of Y, grouped by source^a

a

Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

Subgroup (14d)

AREA SOURCE: VARIABLE EMISSIONS DATA

a

Use this subgroup to describe temporal variations in the emission rates given in 14b. Factors entered multiply the rates in 14b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use BAEMAR.B.DAT and NAR2 > 0.

IVARY determines the type of variation, and is source-specific:

(IVARY) Default: 0

```

0 = Constant
1 = Diurnal cycle (24 scaling factors: hours 1-24)
2 = Monthly cycle (12 scaling factors: months 1-12)
3 = Hour & Season (4 groups of 24 hourly scaling factors,
                     where first group is DEC-JAN-FEB)
4 = Speed & Stab. (6 groups of 6 scaling factors, where
                     first group is Stability Class A,
                     and the speed classes have upper
                     bounds (m/s) defined in Group 12)
5 = Temperature (12 scaling factors, where temperature
                  classes have upper bounds (C) of:
                  0, 5, 10, 15, 20, 25, 30, 35, 40,
                  45, 50, 50+)

```

a

Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters

Subgroup (15a)

Number of buoyant line sources
with variable location and emission
parameters (NLN2) No default ! NLN2 = 0 !

(If NLN2 > 0, ALL parameter data for
these sources are read from the file: LNEMARB.DAT)

Number of buoyant line sources (NLINES) No default ! NLINES = 0 !

Units used for line source
emissions below (ILNU) Default: 1 ! ILNU = 1 !
1 = g/s
2 = kg/hr
3 = lb/hr
4 = tons/yr
5 = Odour Unit * m**3/s (vol. flux of odour compound)
6 = Odour Unit * m**3/min

Number of source-species
combinations with variable
emissions scaling factors
provided below in (15c) (NSLN1) Default: 0 ! NSLN1 = 0 !

Maximum number of segments used to model
each line (MXNSEG) Default: 7 ! MXNSEG = 7 !

The following variables are required only if NLINES > 0. They are
used in the buoyant line source plume rise calculations.

Number of distances at which
transitional rise is computed Default: 6 ! NLRISE = 6 !

Average line source length (XL) No default ! XL = 0. !
(in meters)

Average height of line source height (HBL) No default ! HBL = 0. !
(in meters)

Average building width (WBL) No default ! WBL = 0. !
(in meters)

Average line source width (WML) No default ! WML = 0. !
(in meters)

Average separation between buildings (DXL) No default ! DXL = 0. !
(in meters)

Average buoyancy parameter (FPRIMEL) No default ! FPRIMEL = 0. !
(in m**4/s**3)

!END!

Subgroup (15b)

BUOYANT LINE SOURCE: CONSTANT DATA

a

Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

b

An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by ILNTU (e.g. 1 for g/s).

Subgroup (15c)

BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission rates given in 15b. Factors entered multiply the rates in 15b. Skip sources here that have constant emissions.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

0 = Constant
 1 = Diurnal cycle (24 scaling factors: hours 1-24)
 2 = Monthly cycle (12 scaling factors: months 1-12)
 3 = Hour & Season (4 groups of 24 hourly scaling factors,
 where first group is DEC-JAN-FEB)
 4 = Speed & Stab. (6 groups of 6 scaling factors, where
 first group is Stability Class A,
 and the speed classes have upper
 bounds (m/s) defined in Group 12
 5 = Temperature (12 scaling factors, where temperature
 classes have upper bounds (C) of:
 0, 5, 10, 15, 20, 25, 30, 35, 40,
 45, 50, 50+)

a

Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters

Subgroup (16a)

Number of volume sources with
parameters provided in 16b,c (NVL1) No default ! NVL1 = 0 !

Units used for volume source
emissions below in 16b (IVLU) Default: 1 ! IVLU = 1 !

1 =	g/s
2 =	kg/hr
3 =	lb/hr
4 =	tons/yr
5 =	Odour Unit * m**3/s (vol. flux of odour compound)
6 =	Odour Unit * m**3/min

Number of source-species
combinations with variable
emissions scaling factors
provided below in (16c) (NSVLL1) Default: 0 ! NSVLL1 = 0 !

Gridded volume source data
used ? (IGRDVLL) No default ! IGRDVLL = 0 !

0 = no
1 = yes (gridded volume source emissions read from the file: VOLEM.DAT)

The following parameters apply to the data in the
gridded volume source emissions file (VOLEM.DAT)

- Effective height of emissions
(VEFFHT) in meters No default ! VEFFHT = 0. !
- Initial sigma y (VSIGYI) in
meters No default ! VSIGYI = 0. !
- Initial sigma z (VSIGZI) in
meters No default ! VSIGZI = 0. !

!END!

Subgroup (16b)

a
VOLUME SOURCE: CONSTANT DATA

X UTM Coordinate (km)	Y UTM Coordinate (km)	Effect. Height (m)	Base Elevation (m)	Initial Sigma y (m)	Initial Sigma z (m)	Emission Rates
-----	-----	-----	-----	-----	-----	-----

a

Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

b

An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by IVLU (e.g. 1 for g/s).

Subgroup (16c)

a
VOLUME SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission rates given in 16b. Factors entered multiply the rates in 16b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use VOLEM.DAT and IGRDVL = 1.

IVARY determines the type of variation, and is source-specific:

(IVARY) Default: 0

0 =	Constant
1 =	Diurnal cycle (24 scaling factors: hours 1-24)
2 =	Monthly cycle (12 scaling factors: months 1-12)
3 =	Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
4 =	Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12
5 =	Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)

a

Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information

Subgroup (17a)

Number of non-gridded receptors (NREC) No default ! NREC = 35 !

!END!

Subgroup (17b)

a
NON-GRIDDED (DISCRETE) RECEPTOR DATA

Receptor No.	X UTM Coordinate (km)	Y UTM Coordinate (km)	Ground Elevation (m)		
1 ! X =	566.438,	4192.474,	319.000,	0.000!	!END!
2 ! X =	566.488,	4192.452,	316.000,	0.000!	!END!
3 ! X =	566.535,	4192.426,	329.000,	0.000!	!END!
4 ! X =	566.571,	4192.387,	320.000,	0.000!	!END!
5 ! X =	566.614,	4192.331,	308.000,	0.000!	!END!
6 ! X =	566.755,	4192.198,	283.000,	0.000!	!END!
7 ! X =	566.813,	4191.961,	239.000,	0.000!	!END!
8 ! X =	566.593,	4191.969,	207.000,	0.000!	!END!
9 ! X =	566.441,	4191.955,	226.000,	0.000!	!END!
10 ! X =	566.269,	4191.917,	210.000,	0.000!	!END!
11 ! X =	566.06,	4191.949,	230.000,	0.000!	!END!
12 ! X =	565.725,	4192.032,	155.000,	0.000!	!END!
13 ! X =	565.589,	4192.325,	175.000,	0.000!	!END!
14 ! X =	565.747,	4192.622,	259.000,	0.000!	!END!
15 ! X =	566.37,	4192.401,	343.000,	0.000!	!END!
16 ! X =	566.276,	4192.714,	357.000,	0.000!	!END!
17 ! X =	566.54,	4192.576,	384.000,	0.000!	!END!
18 ! X =	566.566,	4192.332,	332.000,	0.000!	!END!
19 ! X =	566.972,	4192.268,	265.000,	0.000!	!END!
20 ! X =	566.955,	4192.131,	246.000,	0.000!	!END!
21 ! X =	567.2,	4191.85,	236.000,	0.000!	!END!
22 ! X =	566.7,	4191.49,	285.000,	0.000!	!END!
23 ! X =	566.276,	4192.027,	262.000,	0.000!	!END!
24 ! X =	566.131,	4192.085,	268.000,	0.000!	!END!
25 ! X =	566.001,	4192.147,	238.000,	0.000!	!END!
26 ! X =	565.621,	4192.176,	160.000,	0.000!	!END!
27 ! X =	566.063,	4192.329,	244.000,	0.000!	!END!
28 ! X =	565.918,	4192.548,	251.000,	0.000!	!END!
29 ! X =	565.991,	4192.428,	264.000,	0.000!	!END!
30 ! X =	566.383,	4192.428,	344.000,	0.000!	!END!
31 ! X =	566.143,	4192.672,	338.000,	0.000!	!END!
32 ! X =	566.344,	4192.568,	335.000,	0.000!	!END!
33 ! X =	566.488,	4192.299,	297.000,	0.000!	!END!
34 ! X =	566.439,	4192.889,	378.000,	0.000!	!END!
35 ! X =	566.406,	4192.352,	325.000,	0.000!	!END!

a

Data for each receptor are treated as a separate input subgroup and therefore must end with an input group terminator.

Table A.1 Concentrations Estimated using CALPUFF, assuming an annual release of 30 Ci

UTM-E (km)	UTM-N (km)	Conc (pCi/m ³)	UTM-E (km)	UTM-N (km)	Conc (pCi/m ³)
564.560	4190.460	--	564.643	4192.377	0.013
564.643	4190.460	--	564.727	4192.377	0.014
564.727	4190.460	--	564.810	4192.377	0.016
564.810	4190.460	--	564.893	4192.377	0.017
564.893	4190.460	--	564.977	4192.377	0.019
564.977	4190.460	--	565.060	4192.377	0.022
565.060	4190.460	0.010	565.143	4192.377	0.024
565.143	4190.460	0.011	565.227	4192.377	0.026
565.227	4190.460	0.012	565.310	4192.377	0.029
565.310	4190.460	0.012	565.393	4192.377	0.033
565.393	4190.460	0.013	565.477	4192.377	0.039
565.477	4190.460	0.014	565.560	4192.377	0.045
565.560	4190.460	0.015	565.643	4192.377	0.055
565.643	4190.460	0.015	565.727	4192.377	0.068
565.727	4190.460	0.016	565.810	4192.377	0.087
565.810	4190.460	0.017	565.893	4192.377	0.119
565.893	4190.460	0.018	565.977	4192.377	0.170
565.977	4190.460	0.018	566.060	4192.377	0.255
566.060	4190.460	0.019	566.143	4192.377	0.424
566.143	4190.460	0.020	566.227	4192.377	0.798
566.227	4190.460	0.021	566.310	4192.377	1.889
566.310	4190.460	0.023	566.393	4192.377	5.212
566.393	4190.460	0.023	566.477	4192.377	10.146
566.477	4190.460	0.023	566.560	4192.377	22.184
566.560	4190.460	0.024	566.643	4192.377	13.118
566.643	4190.460	0.025	566.727	4192.377	7.920
566.727	4190.460	0.027	566.810	4192.377	5.254
566.810	4190.460	0.029	566.893	4192.377	3.399
566.893	4190.460	0.034	566.977	4192.377	2.379
566.977	4190.460	0.040	567.060	4192.377	1.758
567.060	4190.460	0.049	567.143	4192.377	1.637
567.143	4190.460	0.062	567.227	4192.377	1.626
567.227	4190.460	0.080	567.310	4192.377	1.753
567.310	4190.460	0.108	567.393	4192.377	2.120
567.393	4190.460	0.121	567.477	4192.377	2.895
567.477	4190.460	0.139	567.560	4192.377	3.899
567.560	4190.460	0.161	567.643	4192.377	3.852
567.643	4190.460	0.136	567.727	4192.377	3.508
567.727	4190.460	0.118	567.810	4192.377	3.197
567.810	4190.460	0.105	567.893	4192.377	2.924
567.893	4190.460	0.119	567.977	4192.377	2.675
567.977	4190.460	0.139	568.060	4192.377	2.445
568.060	4190.460	0.166	568.143	4192.377	2.228
568.143	4190.460	0.288	568.227	4192.377	2.018
568.227	4190.460	0.562	568.310	4192.377	1.810
568.310	4190.460	0.565	564.560	4192.460	0.011
564.560	4190.543	--	564.643	4192.460	0.013
564.643	4190.543	--	564.727	4192.460	0.014
564.727	4190.543	--	564.810	4192.460	0.015
564.810	4190.543	--	564.893	4192.460	0.017
564.893	4190.543	--	564.977	4192.460	0.019
564.977	4190.543	0.011	565.060	4192.460	0.021
565.060	4190.543	0.011	565.143	4192.460	0.023
565.143	4190.543	0.012	565.227	4192.460	0.026
565.227	4190.543	0.013	565.310	4192.460	0.029

565.310	4190.543	0.013	565.393	4192.460	0.034
565.393	4190.543	0.014	565.477	4192.460	0.039
565.477	4190.543	0.015	565.560	4192.460	0.047
565.560	4190.543	0.016	565.643	4192.460	0.057
565.643	4190.543	0.017	565.727	4192.460	0.072
565.727	4190.543	0.018	565.810	4192.460	0.093
565.810	4190.543	0.018	565.893	4192.460	0.129
565.893	4190.543	0.019	565.977	4192.460	0.188
565.977	4190.543	0.020	566.060	4192.460	0.292
566.060	4190.543	0.021	566.143	4192.460	0.537
566.143	4190.543	0.022	566.227	4192.460	1.156
566.227	4190.543	0.023	566.310	4192.460	2.923
566.310	4190.543	0.024	566.393	4192.460	6.336
566.393	4190.543	0.025	566.477	4192.460	11.224
566.477	4190.543	0.026	566.560	4192.460	19.536
566.560	4190.543	0.027	566.643	4192.460	15.337
566.643	4190.543	0.029	566.727	4192.460	11.325
566.727	4190.543	0.032	566.810	4192.460	8.487
566.810	4190.543	0.035	566.893	4192.460	4.593
566.893	4190.543	0.040	566.977	4192.460	2.865
566.977	4190.543	0.045	567.060	4192.460	1.965
567.060	4190.543	0.052	567.143	4192.460	2.003
567.143	4190.543	0.063	567.227	4192.460	2.251
567.227	4190.543	0.076	567.310	4192.460	2.885
567.310	4190.543	0.092	567.393	4192.460	4.339
567.393	4190.543	0.109	567.477	4192.460	4.371
567.477	4190.543	0.131	567.560	4192.460	3.971
567.560	4190.543	0.164	567.643	4192.460	3.607
567.643	4190.543	0.160	567.727	4192.460	3.288
567.727	4190.543	0.155	567.810	4192.460	3.006
567.810	4190.543	0.150	567.893	4192.460	2.755
567.893	4190.543	0.180	567.977	4192.460	2.526
567.977	4190.543	0.228	568.060	4192.460	2.313
568.060	4190.543	0.302	568.143	4192.460	2.112
568.143	4190.543	0.534	568.227	4192.460	1.915
568.227	4190.543	0.665	568.310	4192.460	1.721
568.310	4190.543	0.632	568.450	4192.543	0.011
564.560	4190.627	--	564.643	4192.543	0.012
564.643	4190.627	--	564.727	4192.543	0.014
564.727	4190.627	--	564.810	4192.543	0.015
564.810	4190.627	--	564.893	4192.543	0.017
564.893	4190.627	0.010	564.977	4192.543	0.019
564.977	4190.627	0.011	565.060	4192.543	0.021
565.060	4190.627	0.012	565.143	4192.543	0.024
565.143	4190.627	0.013	565.227	4192.543	0.028
565.227	4190.627	0.013	565.310	4192.543	0.032
565.310	4190.627	0.014	565.393	4192.543	0.037
565.393	4190.627	0.015	565.477	4192.543	0.044
565.477	4190.627	0.016	565.560	4192.543	0.053
565.560	4190.627	0.017	565.643	4192.543	0.068
565.643	4190.627	0.018	565.727	4192.543	0.090
565.727	4190.627	0.019	565.810	4192.543	0.123
565.810	4190.627	0.020	565.893	4192.543	0.176
565.893	4190.627	0.021	565.977	4192.543	0.268
565.977	4190.627	0.022	566.060	4192.543	0.438
566.060	4190.627	0.023	566.143	4192.543	0.816
566.143	4190.627	0.024	566.227	4192.543	1.622
566.227	4190.627	0.025	566.310	4192.543	3.183

566.310	4190.627	0.026	566.393	4192.543	5.066
566.393	4190.627	0.027	566.477	4192.543	8.343
566.477	4190.627	0.028	566.560	4192.543	12.980
566.560	4190.627	0.030	566.643	4192.543	13.679
566.643	4190.627	0.033	566.727	4192.543	12.761
566.727	4190.627	0.037	566.810	4192.543	11.116
566.810	4190.627	0.043	566.893	4192.543	8.637
566.893	4190.627	0.047	566.977	4192.543	5.010
566.977	4190.627	0.051	567.060	4192.543	2.962
567.060	4190.627	0.056	567.143	4192.543	3.405
567.143	4190.627	0.064	567.227	4192.543	4.169
567.227	4190.627	0.072	567.310	4192.543	4.662
567.310	4190.627	0.083	567.393	4192.543	4.430
567.393	4190.627	0.102	567.477	4192.543	4.022
567.477	4190.627	0.127	567.560	4192.543	3.657
567.560	4190.627	0.167	567.643	4192.543	3.337
567.643	4190.627	0.186	567.727	4192.543	3.054
567.727	4190.627	0.209	567.810	4192.543	2.802
567.810	4190.627	0.236	567.893	4192.543	2.576
567.893	4190.627	0.313	567.977	4192.543	2.368
567.977	4190.627	0.445	568.060	4192.543	2.173
568.060	4190.627	0.665	568.143	4192.543	1.988
568.143	4190.627	0.771	568.227	4192.543	1.807
568.227	4190.627	0.746	568.310	4192.543	1.627
568.310	4190.627	0.703	564.560	4192.627	0.011
564.560	4190.710	--	564.643	4192.627	0.012
564.643	4190.710	--	564.727	4192.627	0.014
564.727	4190.710	--	564.810	4192.627	0.015
564.810	4190.710	0.010	564.893	4192.627	0.017
564.893	4190.710	0.011	564.977	4192.627	0.019
564.977	4190.710	0.012	565.060	4192.627	0.022
565.060	4190.710	0.013	565.143	4192.627	0.026
565.143	4190.710	0.013	565.227	4192.627	0.030
565.227	4190.710	0.014	565.310	4192.627	0.036
565.310	4190.710	0.015	565.393	4192.627	0.042
565.393	4190.710	0.016	565.477	4192.627	0.051
565.477	4190.710	0.017	565.560	4192.627	0.063
565.560	4190.710	0.018	565.643	4192.627	0.085
565.643	4190.710	0.019	565.727	4192.627	0.119
565.727	4190.710	0.020	565.810	4192.627	0.173
565.810	4190.710	0.021	565.893	4192.627	0.252
565.893	4190.710	0.022	565.977	4192.627	0.387
565.977	4190.710	0.024	566.060	4192.627	0.623
566.060	4190.710	0.025	566.143	4192.627	1.077
566.143	4190.710	0.026	566.227	4192.627	1.854
566.227	4190.710	0.027	566.310	4192.627	3.006
566.310	4190.710	0.028	566.393	4192.627	4.365
566.393	4190.710	0.029	566.477	4192.627	6.710
566.477	4190.710	0.031	566.560	4192.627	9.427
566.560	4190.710	0.033	566.643	4192.627	10.329
566.643	4190.710	0.038	566.727	4192.627	9.760
566.727	4190.710	0.044	566.810	4192.627	8.861
566.810	4190.710	0.053	566.893	4192.627	7.882
566.893	4190.710	0.055	566.977	4192.627	6.946
566.977	4190.710	0.057	567.060	4192.627	5.822
567.060	4190.710	0.059	567.143	4192.627	5.417
567.143	4190.710	0.064	567.227	4192.627	4.910
567.227	4190.710	0.070	567.310	4192.627	4.432

567.310	4190.710	0.075	567.393	4192.627	4.024
567.393	4190.710	0.096	567.477	4192.627	3.664
567.477	4190.710	0.125	567.560	4192.627	3.349
567.560	4190.710	0.171	567.643	4192.627	3.070
567.643	4190.710	0.216	567.727	4192.627	2.823
567.727	4190.710	0.294	567.810	4192.627	2.600
567.810	4190.710	0.438	567.893	4192.627	2.398
567.893	4190.710	0.666	567.977	4192.627	2.210
567.977	4190.710	0.886	568.060	4192.627	2.034
568.060	4190.710	0.903	568.143	4192.627	1.864
568.143	4190.710	0.871	568.227	4192.627	1.698
568.227	4190.710	0.829	568.310	4192.627	1.532
568.310	4190.710	0.777	568.4560	4192.710	0.011
564.560	4190.793	--	564.643	4192.710	0.012
564.643	4190.793	--	564.727	4192.710	0.014
564.727	4190.793	--	564.810	4192.710	0.015
564.810	4190.793	0.011	564.893	4192.710	0.017
564.893	4190.793	0.012	564.977	4192.710	0.020
564.977	4190.793	0.012	565.060	4192.710	0.023
565.060	4190.793	0.013	565.143	4192.710	0.028
565.143	4190.793	0.014	565.227	4192.710	0.034
565.227	4190.793	0.015	565.310	4192.710	0.041
565.310	4190.793	0.016	565.393	4192.710	0.050
565.393	4190.793	0.017	565.477	4192.710	0.062
565.477	4190.793	0.018	565.560	4192.710	0.077
565.560	4190.793	0.019	565.643	4192.710	0.110
565.643	4190.793	0.021	565.727	4192.710	0.162
565.727	4190.793	0.022	565.810	4192.710	0.250
565.810	4190.793	0.023	565.893	4192.710	0.361
565.893	4190.793	0.024	565.977	4192.710	0.538
565.977	4190.793	0.025	566.060	4192.710	0.826
566.060	4190.793	0.026	566.143	4192.710	1.316
566.143	4190.793	0.028	566.227	4192.710	2.020
566.227	4190.793	0.029	566.310	4192.710	3.002
566.310	4190.793	0.030	566.393	4192.710	4.193
566.393	4190.793	0.032	566.477	4192.710	5.756
566.477	4190.793	0.034	566.560	4192.710	7.253
566.560	4190.793	0.037	566.643	4192.710	7.719
566.643	4190.793	0.045	566.727	4192.710	7.480
566.727	4190.793	0.055	566.810	4192.710	7.067
566.810	4190.793	0.068	566.893	4192.710	6.510
566.893	4190.793	0.073	566.977	4192.710	5.914
566.977	4190.793	0.078	567.060	4192.710	5.348
567.060	4190.793	0.083	567.143	4192.710	4.840
567.143	4190.793	0.088	567.227	4192.710	4.390
567.227	4190.793	0.093	567.310	4192.710	3.992
567.310	4190.793	0.098	567.393	4192.710	3.643
567.393	4190.793	0.115	567.477	4192.710	3.336
567.477	4190.793	0.134	567.560	4192.710	3.065
567.560	4190.793	0.158	567.643	4192.710	2.822
567.643	4190.793	0.184	567.727	4192.710	2.604
567.727	4190.793	0.219	567.810	4192.710	2.408
567.810	4190.793	0.271	567.893	4192.710	2.227
567.893	4190.793	0.397	567.977	4192.710	2.058
567.977	4190.793	0.669	568.060	4192.710	1.898
568.060	4190.793	0.972	568.143	4192.710	1.744
568.143	4190.793	0.951	568.227	4192.710	1.591
568.227	4190.793	0.908	568.310	4192.710	1.439

568.310	4190.793	0.852	564.560	4192.793	0.011
564.560	4190.877	--	564.643	4192.793	0.012
564.643	4190.877	--	564.727	4192.793	0.014
564.727	4190.877	0.010	564.810	4192.793	0.015
564.810	4190.877	0.011	564.893	4192.793	0.018
564.893	4190.877	0.012	564.977	4192.793	0.021
564.977	4190.877	0.013	565.060	4192.793	0.025
565.060	4190.877	0.014	565.143	4192.793	0.030
565.143	4190.877	0.015	565.227	4192.793	0.037
565.227	4190.877	0.016	565.310	4192.793	0.046
565.310	4190.877	0.017	565.393	4192.793	0.058
565.393	4190.877	0.018	565.477	4192.793	0.074
565.477	4190.877	0.019	565.560	4192.793	0.096
565.560	4190.877	0.021	565.643	4192.793	0.143
565.643	4190.877	0.022	565.727	4192.793	0.222
565.727	4190.877	0.023	565.810	4192.793	0.366
565.810	4190.877	0.024	565.893	4192.793	0.531
565.893	4190.877	0.026	565.977	4192.793	0.788
565.977	4190.877	0.027	566.060	4192.793	1.188
566.060	4190.877	0.028	566.143	4192.793	1.965
566.143	4190.877	0.030	566.227	4192.793	3.317
566.227	4190.877	0.031	566.310	4192.793	5.331
566.310	4190.877	0.033	566.393	4192.793	5.873
566.393	4190.877	0.035	566.477	4192.793	6.050
566.477	4190.877	0.039	566.560	4192.793	6.045
566.560	4190.877	0.043	566.643	4192.793	5.982
566.643	4190.877	0.053	566.727	4192.793	5.888
566.727	4190.877	0.069	566.810	4192.793	5.692
566.810	4190.877	0.089	566.893	4192.793	5.388
566.893	4190.877	0.099	566.977	4192.793	5.021
566.977	4190.877	0.109	567.060	4192.793	4.629
567.060	4190.877	0.119	567.143	4192.793	4.250
567.143	4190.877	0.123	567.227	4192.793	3.900
567.227	4190.877	0.127	567.310	4192.793	3.583
567.310	4190.877	0.130	567.393	4192.793	3.298
567.393	4190.877	0.137	567.477	4192.793	3.040
567.477	4190.877	0.144	567.560	4192.793	2.806
567.560	4190.877	0.150	567.643	4192.793	2.595
567.643	4190.877	0.167	567.727	4192.793	2.405
567.727	4190.877	0.185	567.810	4192.793	2.230
567.810	4190.877	0.207	567.893	4192.793	2.068
567.893	4190.877	0.278	567.977	4192.793	1.915
567.977	4190.877	0.445	568.060	4192.793	1.771
568.060	4190.877	0.890	568.143	4192.793	1.629
568.143	4190.877	0.866	568.227	4192.793	1.489
568.227	4190.877	0.829	568.310	4192.793	1.351
568.310	4190.877	0.783	564.560	4192.877	0.011
564.560	4190.960	--	564.643	4192.877	0.012
564.643	4190.960	--	564.727	4192.877	0.014
564.727	4190.960	0.010	564.810	4192.877	0.016
564.810	4190.960	0.011	564.893	4192.877	0.019
564.893	4190.960	0.012	564.977	4192.877	0.022
564.977	4190.960	0.013	565.060	4192.877	0.027
565.060	4190.960	0.014	565.143	4192.877	0.033
565.143	4190.960	0.016	565.227	4192.877	0.041
565.227	4190.960	0.017	565.310	4192.877	0.053
565.310	4190.960	0.018	565.393	4192.877	0.068
565.393	4190.960	0.019	565.477	4192.877	0.089

565.477	4190.960	0.020	565.560	4192.877	0.120
565.560	4190.960	0.022	565.643	4192.877	0.186
565.643	4190.960	0.023	565.727	4192.877	0.307
565.727	4190.960	0.024	565.810	4192.877	0.562
565.810	4190.960	0.026	565.893	4192.877	0.828
565.893	4190.960	0.027	565.977	4192.877	1.244
565.977	4190.960	0.029	566.060	4192.877	1.892
566.060	4190.960	0.030	566.143	4192.877	3.372
566.143	4190.960	0.032	566.227	4192.877	4.615
566.227	4190.960	0.034	566.310	4192.877	4.815
566.310	4190.960	0.035	566.393	4192.877	4.836
566.393	4190.960	0.039	566.477	4192.877	4.845
566.477	4190.960	0.043	566.560	4192.877	4.821
566.560	4190.960	0.049	566.643	4192.877	4.780
566.643	4190.960	0.064	566.727	4192.877	4.743
566.727	4190.960	0.086	566.810	4192.877	4.661
566.810	4190.960	0.118	566.893	4192.877	4.502
566.893	4190.960	0.136	566.977	4192.877	4.275
566.977	4190.960	0.156	567.060	4192.877	4.008
567.060	4190.960	0.179	567.143	4192.877	3.728
567.143	4190.960	0.178	567.227	4192.877	3.459
567.227	4190.960	0.177	567.310	4192.877	3.209
567.310	4190.960	0.175	567.393	4192.877	2.978
567.393	4190.960	0.164	567.477	4192.877	2.766
567.477	4190.960	0.154	567.560	4192.877	2.570
567.560	4190.960	0.145	567.643	4192.877	2.389
567.643	4190.960	0.156	567.727	4192.877	2.222
567.727	4190.960	0.167	567.810	4192.877	2.067
567.810	4190.960	0.178	567.893	4192.877	1.922
567.893	4190.960	0.226	567.977	4192.877	1.785
567.977	4190.960	0.330	568.060	4192.877	1.653
568.060	4190.960	0.652	568.143	4192.877	1.523
568.143	4190.960	0.566	568.227	4192.877	1.395
568.227	4190.960	0.487	568.310	4192.877	1.267
568.310	4190.960	0.415	564.560	4192.960	0.011
564.560	4191.043	--	564.643	4192.960	0.012
564.643	4191.043	--	564.727	4192.960	0.014
564.727	4191.043	0.011	564.810	4192.960	0.016
564.810	4191.043	0.012	564.893	4192.960	0.020
564.893	4191.043	0.013	564.977	4192.960	0.024
564.977	4191.043	0.014	565.060	4192.960	0.029
565.060	4191.043	0.015	565.143	4192.960	0.037
565.143	4191.043	0.016	565.227	4192.960	0.047
565.227	4191.043	0.017	565.310	4192.960	0.060
565.310	4191.043	0.019	565.393	4192.960	0.080
565.393	4191.043	0.020	565.477	4192.960	0.108
565.477	4191.043	0.022	565.560	4192.960	0.148
565.560	4191.043	0.023	565.643	4192.960	0.242
565.643	4191.043	0.025	565.727	4192.960	0.436
565.727	4191.043	0.026	565.810	4192.960	0.959
565.810	4191.043	0.027	565.893	4192.960	1.451
565.893	4191.043	0.029	565.977	4192.960	2.183
565.977	4191.043	0.031	566.060	4192.960	3.158
566.060	4191.043	0.033	566.143	4192.960	3.703
566.143	4191.043	0.035	566.227	4192.960	3.890
566.227	4191.043	0.037	566.310	4192.960	3.951
566.310	4191.043	0.039	566.393	4192.960	3.965
566.393	4191.043	0.044	566.477	4192.960	3.956

566.477	4191.043	0.051	566.560	4192.960	3.933
566.560	4191.043	0.061	566.643	4192.960	3.914
566.643	4191.043	0.081	566.727	4192.960	3.901
566.727	4191.043	0.109	566.810	4192.960	3.872
566.810	4191.043	0.149	566.893	4192.960	3.794
566.893	4191.043	0.178	566.977	4192.960	3.658
566.977	4191.043	0.212	567.060	4192.960	3.476
567.060	4191.043	0.256	567.143	4192.960	3.275
567.143	4191.043	0.255	567.227	4192.960	3.070
567.227	4191.043	0.253	567.310	4192.960	2.872
567.310	4191.043	0.251	567.393	4192.960	2.687
567.393	4191.043	0.232	567.477	4192.960	2.511
567.477	4191.043	0.216	567.560	4192.960	2.348
567.560	4191.043	0.202	567.643	4192.960	2.195
567.643	4191.043	0.201	567.727	4192.960	2.053
567.727	4191.043	0.198	567.810	4192.960	1.917
567.810	4191.043	0.195	567.893	4192.960	1.788
567.893	4191.043	0.232	567.977	4192.960	1.665
567.977	4191.043	0.301	568.060	4192.960	1.546
568.060	4191.043	0.463	568.143	4192.960	1.427
568.143	4191.043	0.575	568.227	4192.960	1.309
568.227	4191.043	0.742	568.310	4192.960	1.191
568.310	4191.043	0.942	564.560	4193.043	0.011
564.560	4191.127	--	564.643	4193.043	0.013
564.643	4191.127	--	564.727	4193.043	0.015
564.727	4191.127	0.011	564.810	4193.043	0.017
564.810	4191.127	0.012	564.893	4193.043	0.021
564.893	4191.127	0.013	564.977	4193.043	0.026
564.977	4191.127	0.014	565.060	4193.043	0.032
565.060	4191.127	0.015	565.143	4193.043	0.039
565.143	4191.127	0.017	565.227	4193.043	0.049
565.227	4191.127	0.018	565.310	4193.043	0.061
565.310	4191.127	0.019	565.393	4193.043	0.082
565.393	4191.127	0.021	565.477	4193.043	0.113
565.477	4191.127	0.023	565.560	4193.043	0.157
565.560	4191.127	0.025	565.643	4193.043	0.236
565.643	4191.127	0.026	565.727	4193.043	0.372
565.727	4191.127	0.028	565.810	4193.043	0.639
565.810	4191.127	0.029	565.893	4193.043	0.994
565.893	4191.127	0.031	565.977	4193.043	1.620
565.977	4191.127	0.034	566.060	4193.043	2.626
566.060	4191.127	0.036	566.143	4193.043	3.167
566.143	4191.127	0.038	566.227	4193.043	3.280
566.227	4191.127	0.040	566.310	4193.043	3.302
566.310	4191.127	0.043	566.393	4193.043	3.303
566.393	4191.127	0.051	566.477	4193.043	3.287
566.477	4191.127	0.061	566.560	4193.043	3.269
566.560	4191.127	0.076	566.643	4193.043	3.260
566.643	4191.127	0.102	566.727	4193.043	3.258
566.727	4191.127	0.138	566.810	4193.043	3.257
566.810	4191.127	0.193	566.893	4193.043	3.224
566.893	4191.127	0.240	566.977	4193.043	3.144
566.977	4191.127	0.306	567.060	4193.043	3.026
567.060	4191.127	0.405	567.143	4193.043	2.883
567.143	4191.127	0.406	567.227	4193.043	2.730
567.227	4191.127	0.405	567.310	4193.043	2.575
567.310	4191.127	0.402	567.393	4193.043	2.424
567.393	4191.127	0.361	567.477	4193.043	2.279

567.477	4191.127	0.327	567.560	4193.043	2.143
567.560	4191.127	0.297	567.643	4193.043	2.015
567.643	4191.127	0.263	567.727	4193.043	1.893
567.727	4191.127	0.235	567.810	4193.043	1.776
567.810	4191.127	0.212	567.893	4193.043	1.664
567.893	4191.127	0.240	567.977	4193.043	1.554
567.977	4191.127	0.282	568.060	4193.043	1.446
568.060	4191.127	0.359	568.143	4193.043	1.338
568.143	4191.127	0.581	568.227	4193.043	1.230
568.227	4191.127	1.130	568.310	4193.043	1.119
568.310	4191.127	1.199	564.560	4193.127	0.011
564.560	4191.210	--	564.643	4193.127	0.013
564.643	4191.210	--	564.727	4193.127	0.015
564.727	4191.210	0.011	564.810	4193.127	0.018
564.810	4191.210	0.012	564.893	4193.127	0.022
564.893	4191.210	0.013	564.977	4193.127	0.028
564.977	4191.210	0.015	565.060	4193.127	0.035
565.060	4191.210	0.016	565.143	4193.127	0.042
565.143	4191.210	0.017	565.227	4193.127	0.051
565.227	4191.210	0.019	565.310	4193.127	0.062
565.310	4191.210	0.020	565.393	4193.127	0.084
565.393	4191.210	0.022	565.477	4193.127	0.117
565.477	4191.210	0.024	565.560	4193.127	0.163
565.560	4191.210	0.026	565.643	4193.127	0.227
565.643	4191.210	0.028	565.727	4193.127	0.321
565.727	4191.210	0.029	565.810	4193.127	0.464
565.810	4191.210	0.031	565.893	4193.127	0.714
565.893	4191.210	0.033	565.977	4193.127	1.196
565.977	4191.210	0.036	566.060	4193.127	2.146
566.060	4191.210	0.039	566.143	4193.127	2.711
566.143	4191.210	0.042	566.227	4193.127	2.785
566.227	4191.210	0.045	566.310	4193.127	2.790
566.310	4191.210	0.048	566.393	4193.127	2.787
566.393	4191.210	0.058	566.477	4193.127	2.772
566.477	4191.210	0.074	566.560	4193.127	2.758
566.560	4191.210	0.097	566.643	4193.127	2.755
566.643	4191.210	0.131	566.727	4193.127	2.756
566.727	4191.210	0.181	566.810	4193.127	2.763
566.810	4191.210	0.258	566.893	4193.127	2.753
566.893	4191.210	0.345	566.977	4193.127	2.715
566.977	4191.210	0.492	567.060	4193.127	2.641
567.060	4191.210	0.758	567.143	4193.127	2.544
567.143	4191.210	0.780	567.227	4193.127	2.430
567.227	4191.210	0.798	567.310	4193.127	2.312
567.310	4191.210	0.810	567.393	4193.127	2.190
567.393	4191.210	0.704	567.477	4193.127	2.071
567.477	4191.210	0.614	567.560	4193.127	1.957
567.560	4191.210	0.538	567.643	4193.127	1.848
567.643	4191.210	0.364	567.727	4193.127	1.744
567.727	4191.210	0.280	567.810	4193.127	1.642
567.810	4191.210	0.230	567.893	4193.127	1.545
567.893	4191.210	0.247	567.977	4193.127	1.448
567.977	4191.210	0.270	568.060	4193.127	1.351
568.060	4191.210	0.302	568.143	4193.127	1.254
568.143	4191.210	0.586	568.227	4193.127	1.155
568.227	4191.210	1.382	568.310	4193.127	1.053
568.310	4191.210	1.300	564.560	4193.210	0.012
564.560	4191.293	--	564.643	4193.210	0.014

564.643	4191.293	0.010	564.727	4193.210	0.016
564.727	4191.293	0.011	564.810	4193.210	0.019
564.810	4191.293	0.012	564.893	4193.210	0.024
564.893	4191.293	0.014	564.977	4193.210	0.030
564.977	4191.293	0.015	565.060	4193.210	0.039
565.060	4191.293	0.016	565.143	4193.210	0.045
565.143	4191.293	0.018	565.227	4193.210	0.053
565.227	4191.293	0.019	565.310	4193.210	0.062
565.310	4191.293	0.021	565.393	4193.210	0.085
565.393	4191.293	0.023	565.477	4193.210	0.119
565.477	4191.293	0.025	565.560	4193.210	0.167
565.560	4191.293	0.027	565.643	4193.210	0.215
565.643	4191.293	0.029	565.727	4193.210	0.277
565.727	4191.293	0.031	565.810	4193.210	0.354
565.810	4191.293	0.033	565.893	4193.210	0.534
565.893	4191.293	0.036	565.977	4193.210	0.899
565.977	4191.293	0.039	566.060	4193.210	1.747
566.060	4191.293	0.042	566.143	4193.210	2.323
566.143	4191.293	0.046	566.227	4193.210	2.383
566.227	4191.293	0.050	566.310	4193.210	2.381
566.310	4191.293	0.056	566.393	4193.210	2.377
566.393	4191.293	0.067	566.477	4193.210	2.365
566.477	4191.293	0.086	566.560	4193.210	2.354
566.560	4191.293	0.113	566.643	4193.210	2.354
566.643	4191.293	0.151	566.727	4193.210	2.356
566.727	4191.293	0.205	566.810	4193.210	2.364
566.810	4191.293	0.283	566.893	4193.210	2.369
566.893	4191.293	0.395	566.977	4193.210	2.354
566.977	4191.293	0.606	567.060	4193.210	2.314
567.060	4191.293	1.061	567.143	4193.210	2.250
567.143	4191.293	1.040	567.227	4193.210	2.169
567.227	4191.293	1.013	567.310	4193.210	2.077
567.310	4191.293	0.974	567.393	4193.210	1.981
567.393	4191.293	0.972	567.477	4193.210	1.885
567.477	4191.293	0.961	567.560	4193.210	1.790
567.560	4191.293	0.944	567.643	4193.210	1.697
567.643	4191.293	0.594	567.727	4193.210	1.605
567.727	4191.293	0.417	567.810	4193.210	1.518
567.810	4191.293	0.325	567.893	4193.210	1.432
567.893	4191.293	0.315	567.977	4193.210	1.347
567.977	4191.293	0.304	568.060	4193.210	1.261
568.060	4191.293	0.291	568.143	4193.210	1.173
568.143	4191.293	0.474	568.227	4193.210	1.083
568.227	4191.293	1.251	568.310	4193.210	0.990
568.310	4191.293	1.402	564.560	4193.293	0.013
564.560	4191.377	--	564.643	4193.293	0.015
564.643	4191.377	0.011	564.727	4193.293	0.018
564.727	4191.377	0.012	564.810	4193.293	0.021
564.810	4191.377	0.013	564.893	4193.293	0.026
564.893	4191.377	0.014	564.977	4193.293	0.033
564.977	4191.377	0.015	565.060	4193.293	0.041
565.060	4191.377	0.017	565.143	4193.293	0.049
565.143	4191.377	0.018	565.227	4193.293	0.059
565.227	4191.377	0.020	565.310	4193.293	0.071
565.310	4191.377	0.022	565.393	4193.293	0.096
565.393	4191.377	0.024	565.477	4193.293	0.132
565.477	4191.377	0.026	565.560	4193.293	0.183
565.560	4191.377	0.029	565.643	4193.293	0.238

565.643	4191.377	0.031	565.727	4193.293	0.309
565.727	4191.377	0.033	565.810	4193.293	0.404
565.810	4191.377	0.035	565.893	4193.293	0.609
565.893	4191.377	0.038	565.977	4193.293	1.030
565.977	4191.377	0.042	566.060	4193.293	1.836
566.060	4191.377	0.045	566.143	4193.293	2.042
566.143	4191.377	0.051	566.227	4193.293	2.052
566.227	4191.377	0.057	566.310	4193.293	2.052
566.310	4191.377	0.065	566.393	4193.293	2.049
566.393	4191.377	0.079	566.477	4193.293	2.040
566.477	4191.377	0.101	566.560	4193.293	2.034
566.560	4191.377	0.133	566.643	4193.293	2.033
566.643	4191.377	0.176	566.727	4193.293	2.037
566.727	4191.377	0.234	566.810	4193.293	2.043
566.810	4191.377	0.314	566.893	4193.293	2.054
566.893	4191.377	0.457	566.977	4193.293	2.052
566.977	4191.377	0.759	567.060	4193.293	2.034
567.060	4191.377	1.539	567.143	4193.293	1.995
567.143	4191.377	1.416	567.227	4193.293	1.940
567.227	4191.377	1.295	567.310	4193.293	1.872
567.310	4191.377	1.174	567.393	4193.293	1.796
567.393	4191.377	1.383	567.477	4193.293	1.718
567.477	4191.377	1.653	567.560	4193.293	1.638
567.560	4191.377	1.926	567.643	4193.293	1.558
567.643	4191.377	1.221	567.727	4193.293	1.480
567.727	4191.377	0.797	567.810	4193.293	1.403
567.810	4191.377	0.565	567.893	4193.293	1.327
567.893	4191.377	0.427	567.977	4193.293	1.251
567.977	4191.377	0.343	568.060	4193.293	1.174
568.060	4191.377	0.284	568.143	4193.293	1.096
568.143	4191.377	0.399	568.227	4193.293	1.013
568.227	4191.377	0.812	568.310	4193.293	0.928
568.310	4191.377	1.494	568.493	4193.377	0.014
564.560	4191.460	--	564.643	4193.377	0.017
564.643	4191.460	0.011	564.727	4193.377	0.020
564.727	4191.460	0.012	564.810	4193.377	0.024
564.810	4191.460	0.013	564.893	4193.377	0.029
564.893	4191.460	0.015	564.977	4193.377	0.036
564.977	4191.460	0.016	565.060	4193.377	0.044
565.060	4191.460	0.017	565.143	4193.377	0.053
565.143	4191.460	0.019	565.227	4193.377	0.065
565.227	4191.460	0.021	565.310	4193.377	0.080
565.310	4191.460	0.023	565.393	4193.377	0.107
565.393	4191.460	0.025	565.477	4193.377	0.145
565.477	4191.460	0.027	565.560	4193.377	0.198
565.560	4191.460	0.030	565.643	4193.377	0.260
565.643	4191.460	0.033	565.727	4193.377	0.346
565.727	4191.460	0.035	565.810	4193.377	0.472
565.810	4191.460	0.038	565.893	4193.377	0.718
565.893	4191.460	0.041	565.977	4193.377	1.191
565.977	4191.460	0.045	566.060	4193.377	1.739
566.060	4191.460	0.049	566.143	4193.377	1.787
566.143	4191.460	0.056	566.227	4193.377	1.786
566.227	4191.460	0.065	566.310	4193.377	1.785
566.310	4191.460	0.076	566.393	4193.377	1.783
566.393	4191.460	0.094	566.477	4193.377	1.777
566.477	4191.460	0.120	566.560	4193.377	1.773
566.560	4191.460	0.158	566.643	4193.377	1.774

566.643	4191.460	0.207	566.727	4193.377	1.776
566.727	4191.460	0.271	566.810	4193.377	1.773
566.810	4191.460	0.352	566.893	4193.377	1.792
566.893	4191.460	0.533	566.977	4193.377	1.800
566.977	4191.460	0.966	567.060	4193.377	1.796
567.060	4191.460	2.221	567.143	4193.377	1.775
567.143	4191.460	1.978	567.227	4193.377	1.739
567.227	4191.460	1.682	567.310	4193.377	1.690
567.310	4191.460	1.422	567.393	4193.377	1.632
567.393	4191.460	2.045	567.477	4193.377	1.568
567.477	4191.460	2.509	567.560	4193.377	1.500
567.560	4191.460	2.576	567.643	4193.377	1.432
567.643	4191.460	2.437	567.727	4193.377	1.365
567.727	4191.460	2.108	567.810	4193.377	1.298
567.810	4191.460	1.547	567.893	4193.377	1.230
567.893	4191.460	0.660	567.977	4193.377	1.161
567.977	4191.460	0.389	568.060	4193.377	1.092
568.060	4191.460	0.280	568.143	4193.377	1.021
568.143	4191.460	0.353	568.227	4193.377	0.946
568.227	4191.460	0.565	568.310	4193.377	0.868
568.310	4191.460	1.314	568.493	4193.460	0.016
564.560	4191.543	0.010	564.643	4193.460	0.019
564.643	4191.543	0.011	564.727	4193.460	0.022
564.727	4191.543	0.012	564.810	4193.460	0.027
564.810	4191.543	0.014	564.893	4193.460	0.032
564.893	4191.543	0.015	564.977	4193.460	0.038
564.977	4191.543	0.016	565.060	4193.460	0.046
565.060	4191.543	0.018	565.143	4193.460	0.057
565.143	4191.543	0.020	565.227	4193.460	0.071
565.227	4191.543	0.021	565.310	4193.460	0.089
565.310	4191.543	0.023	565.393	4193.460	0.118
565.393	4191.543	0.026	565.477	4193.460	0.157
565.477	4191.543	0.029	565.560	4193.460	0.212
565.560	4191.543	0.032	565.643	4193.460	0.284
565.643	4191.543	0.035	565.727	4193.460	0.392
565.727	4191.543	0.037	565.810	4193.460	0.576
565.810	4191.543	0.040	565.893	4193.460	0.878
565.893	4191.543	0.044	565.977	4193.460	1.364
565.977	4191.543	0.048	566.060	4193.460	1.561
566.060	4191.543	0.053	566.143	4193.460	1.571
566.143	4191.543	0.060	566.227	4193.460	1.566
566.227	4191.543	0.069	566.310	4193.460	1.566
566.310	4191.543	0.080	566.393	4193.460	1.565
566.393	4191.543	0.097	566.477	4193.460	1.561
566.477	4191.543	0.125	566.560	4193.460	1.558
566.560	4191.543	0.166	566.643	4193.460	1.560
566.643	4191.543	0.219	566.727	4193.460	1.556
566.727	4191.543	0.289	566.810	4193.460	1.474
566.810	4191.543	0.372	566.893	4193.460	1.511
566.893	4191.543	0.489	566.977	4193.460	1.542
566.977	4191.543	0.661	567.060	4193.460	1.561
567.060	4191.543	0.985	567.143	4193.460	1.573
567.143	4191.543	0.984	567.227	4193.460	1.558
567.227	4191.543	0.969	567.310	4193.460	1.526
567.310	4191.543	0.945	567.393	4193.460	1.482
567.393	4191.543	1.294	567.477	4193.460	1.432
567.477	4191.543	1.930	567.560	4193.460	1.376
567.560	4191.543	2.657	567.643	4193.460	1.318

567.643	4191.543	2.503	567.727	4193.460	1.260
567.727	4191.543	2.341	567.810	4193.460	1.200
567.810	4191.543	2.172	567.893	4193.460	1.140
567.893	4191.543	1.298	567.977	4193.460	1.079
567.977	4191.543	0.808	568.060	4193.460	1.016
568.060	4191.543	0.554	568.143	4193.460	0.950
568.143	4191.543	0.720	568.227	4193.460	0.882
568.227	4191.543	1.036	568.310	4193.460	0.811
568.310	4191.543	1.512	564.560	4193.543	0.017
564.560	4191.627	0.011	564.643	4193.543	0.021
564.643	4191.627	0.012	564.727	4193.543	0.025
564.727	4191.627	0.013	564.810	4193.543	0.031
564.810	4191.627	0.014	564.893	4193.543	0.037
564.893	4191.627	0.015	564.977	4193.543	0.044
564.977	4191.627	0.017	565.060	4193.543	0.052
565.060	4191.627	0.018	565.143	4193.543	0.064
565.143	4191.627	0.020	565.227	4193.543	0.080
565.227	4191.627	0.022	565.310	4193.543	0.098
565.310	4191.627	0.024	565.393	4193.543	0.129
565.393	4191.627	0.027	565.477	4193.543	0.172
565.477	4191.627	0.030	565.560	4193.543	0.232
565.560	4191.627	0.034	565.643	4193.543	0.295
565.643	4191.627	0.037	565.727	4193.543	0.384
565.727	4191.627	0.040	565.810	4193.543	0.517
565.810	4191.627	0.043	565.893	4193.543	0.807
565.893	4191.627	0.048	565.977	4193.543	1.271
565.977	4191.627	0.053	566.060	4193.543	1.388
566.060	4191.627	0.058	566.143	4193.543	1.388
566.143	4191.627	0.065	566.227	4193.543	1.383
566.227	4191.627	0.074	566.310	4193.543	1.384
566.310	4191.627	0.083	566.393	4193.543	1.384
566.393	4191.627	0.101	566.477	4193.543	1.381
566.477	4191.627	0.131	566.560	4193.543	1.380
566.560	4191.627	0.176	566.643	4193.543	1.381
566.643	4191.627	0.237	566.727	4193.543	1.361
566.727	4191.627	0.313	566.810	4193.543	1.151
566.810	4191.627	0.405	566.893	4193.543	1.187
566.893	4191.627	0.481	566.977	4193.543	1.224
566.977	4191.627	0.558	567.060	4193.543	1.257
567.060	4191.627	0.637	567.143	4193.543	1.361
567.143	4191.627	0.667	567.227	4193.543	1.390
567.227	4191.627	0.694	567.310	4193.543	1.378
567.310	4191.627	0.721	567.393	4193.543	1.347
567.393	4191.627	0.914	567.477	4193.543	1.308
567.477	4191.627	1.267	567.560	4193.543	1.263
567.560	4191.627	1.994	567.643	4193.543	1.214
567.643	4191.627	2.353	567.727	4193.543	1.163
567.727	4191.627	2.595	567.810	4193.543	1.110
567.810	4191.627	2.664	567.893	4193.543	1.057
567.893	4191.627	2.528	567.977	4193.543	1.001
567.977	4191.627	2.386	568.060	4193.543	0.944
568.060	4191.627	2.238	568.143	4193.543	0.884
568.143	4191.627	2.063	568.227	4193.543	0.821
568.227	4191.627	1.878	568.310	4193.543	0.756
568.310	4191.627	1.685	564.560	4193.627	0.018
564.560	4191.710	0.011	564.643	4193.627	0.023
564.643	4191.710	0.012	564.727	4193.627	0.028
564.727	4191.710	0.013	564.810	4193.627	0.035

564.810	4191.710	0.015	564.893	4193.627	0.042
564.893	4191.710	0.016	564.977	4193.627	0.049
564.977	4191.710	0.017	565.060	4193.627	0.059
565.060	4191.710	0.019	565.143	4193.627	0.072
565.143	4191.710	0.021	565.227	4193.627	0.088
565.227	4191.710	0.023	565.310	4193.627	0.107
565.310	4191.710	0.025	565.393	4193.627	0.141
565.393	4191.710	0.028	565.477	4193.627	0.186
565.477	4191.710	0.032	565.560	4193.627	0.253
565.560	4191.710	0.036	565.643	4193.627	0.306
565.643	4191.710	0.039	565.727	4193.627	0.374
565.727	4191.710	0.042	565.810	4193.627	0.463
565.810	4191.710	0.046	565.893	4193.627	0.741
565.893	4191.710	0.052	565.977	4193.627	1.173
565.977	4191.710	0.058	566.060	4193.627	1.237
566.060	4191.710	0.064	566.143	4193.627	1.233
566.143	4191.710	0.071	566.227	4193.627	1.229
566.227	4191.710	0.078	566.310	4193.627	1.230
566.310	4191.710	0.088	566.393	4193.627	1.231
566.393	4191.710	0.107	566.477	4193.627	1.230
566.477	4191.710	0.139	566.560	4193.627	1.229
566.560	4191.710	0.191	566.643	4193.627	1.229
566.643	4191.710	0.262	566.727	4193.627	1.164
566.727	4191.710	0.350	566.810	4193.627	0.871
566.810	4191.710	0.451	566.893	4193.627	0.883
566.893	4191.710	0.495	566.977	4193.627	0.898
566.977	4191.710	0.525	567.060	4193.627	0.913
567.060	4191.710	0.540	567.143	4193.627	1.086
567.143	4191.710	0.571	567.227	4193.627	1.209
567.227	4191.710	0.599	567.310	4193.627	1.238
567.310	4191.710	0.630	567.393	4193.627	1.224
567.393	4191.710	0.730	567.477	4193.627	1.194
567.477	4191.710	0.936	567.560	4193.627	1.158
567.560	4191.710	1.352	567.643	4193.627	1.118
567.643	4191.710	1.987	567.727	4193.627	1.074
567.727	4191.710	2.860	567.810	4193.627	1.028
567.810	4191.710	2.982	567.893	4193.627	0.979
567.893	4191.710	2.833	567.977	4193.627	0.929
567.977	4191.710	2.656	568.060	4193.627	0.877
568.060	4191.710	2.474	568.143	4193.627	0.822
568.143	4191.710	2.285	568.227	4193.627	0.764
568.227	4191.710	2.087	568.310	4193.627	0.704
568.310	4191.710	1.816	564.560	4193.710	0.019
564.560	4191.793	0.012	564.643	4193.710	0.024
564.643	4191.793	0.013	564.727	4193.710	0.031
564.727	4191.793	0.014	564.810	4193.710	0.040
564.810	4191.793	0.015	564.893	4193.710	0.047
564.893	4191.793	0.017	564.977	4193.710	0.056
564.977	4191.793	0.018	565.060	4193.710	0.065
565.060	4191.793	0.020	565.143	4193.710	0.079
565.143	4191.793	0.022	565.227	4193.710	0.096
565.227	4191.793	0.024	565.310	4193.710	0.116
565.310	4191.793	0.026	565.393	4193.710	0.152
565.393	4191.793	0.029	565.477	4193.710	0.202
565.477	4191.793	0.033	565.560	4193.710	0.279
565.560	4191.793	0.037	565.643	4193.710	0.319
565.643	4191.793	0.041	565.727	4193.710	0.363
565.727	4191.793	0.046	565.810	4193.710	0.414

565.810	4191.793	0.050	565.893	4193.710	0.679
565.893	4191.793	0.058	565.977	4193.710	1.073
565.977	4191.793	0.066	566.060	4193.710	1.104
566.060	4191.793	0.075	566.143	4193.710	1.100
566.143	4191.793	0.085	566.227	4193.710	1.097
566.227	4191.793	0.098	566.310	4193.710	1.099
566.310	4191.793	0.114	566.393	4193.710	1.100
566.393	4191.793	0.134	566.477	4193.710	1.100
566.477	4191.793	0.168	566.560	4193.710	1.100
566.560	4191.793	0.221	566.643	4193.710	1.094
566.643	4191.793	0.302	566.727	4193.710	0.941
566.727	4191.793	0.396	566.810	4193.710	0.664
566.810	4191.793	0.491	566.893	4193.710	0.660
566.893	4191.793	0.535	566.977	4193.710	0.660
566.977	4191.793	0.557	567.060	4193.710	0.660
567.060	4191.793	0.563	567.143	4193.710	0.815
567.143	4191.793	0.587	567.227	4193.710	0.991
567.227	4191.793	0.604	567.310	4193.710	1.099
567.310	4191.793	0.623	567.393	4193.710	1.107
567.393	4191.793	0.696	567.477	4193.710	1.089
567.477	4191.793	0.841	567.560	4193.710	1.061
567.560	4191.793	1.180	567.643	4193.710	1.028
567.643	4191.793	1.383	567.727	4193.710	0.991
567.727	4191.793	1.677	567.810	4193.710	0.951
567.810	4191.793	2.106	567.893	4193.710	0.908
567.893	4191.793	2.946	567.977	4193.710	0.862
567.977	4191.793	2.789	568.060	4193.710	0.814
568.060	4191.793	2.581	568.143	4193.710	0.764
568.143	4191.793	2.371	568.227	4193.710	0.711
568.227	4191.793	2.160	568.310	4193.710	0.655
568.310	4191.793	1.944	564.560	4193.793	0.021
564.560	4191.877	0.012	564.643	4193.793	0.026
564.643	4191.877	0.013	564.727	4193.793	0.034
564.727	4191.877	0.014	564.810	4193.793	0.043
564.810	4191.877	0.016	564.893	4193.793	0.051
564.893	4191.877	0.017	564.977	4193.793	0.060
564.977	4191.877	0.019	565.060	4193.793	0.070
565.060	4191.877	0.021	565.143	4193.793	0.085
565.143	4191.877	0.023	565.227	4193.793	0.105
565.227	4191.877	0.025	565.310	4193.793	0.128
565.310	4191.877	0.027	565.393	4193.793	0.164
565.393	4191.877	0.030	565.477	4193.793	0.216
565.477	4191.877	0.034	565.560	4193.793	0.296
565.560	4191.877	0.039	565.643	4193.793	0.358
565.643	4191.877	0.043	565.727	4193.793	0.438
565.727	4191.877	0.049	565.810	4193.793	0.544
565.810	4191.877	0.055	565.893	4193.793	0.765
565.893	4191.877	0.065	565.977	4193.793	0.968
565.977	4191.877	0.076	566.060	4193.793	0.988
566.060	4191.877	0.089	566.143	4193.793	0.984
566.143	4191.877	0.105	566.227	4193.793	0.982
566.227	4191.877	0.125	566.310	4193.793	0.984
566.310	4191.877	0.154	566.393	4193.793	0.986
566.393	4191.877	0.172	566.477	4193.793	0.985
566.477	4191.877	0.207	566.560	4193.793	0.975
566.560	4191.877	0.267	566.643	4193.793	0.867
566.643	4191.877	0.367	566.727	4193.793	0.661
566.727	4191.877	0.471	566.810	4193.793	0.503

566.810	4191.877	0.563	566.893	4193.793	0.551
566.893	4191.877	0.602	566.977	4193.793	0.607
566.977	4191.877	0.615	567.060	4193.793	0.669
567.060	4191.877	0.608	567.143	4193.793	0.868
567.143	4191.877	0.620	567.227	4193.793	1.003
567.227	4191.877	0.628	567.310	4193.793	1.020
567.310	4191.877	0.636	567.393	4193.793	1.011
567.393	4191.877	0.690	567.477	4193.793	0.994
567.477	4191.877	0.795	567.560	4193.793	0.971
567.560	4191.877	1.061	567.643	4193.793	0.944
567.643	4191.877	1.048	567.727	4193.793	0.913
567.727	4191.877	1.038	567.810	4193.793	0.878
567.810	4191.877	1.031	567.893	4193.793	0.840
567.893	4191.877	2.333	567.977	4193.793	0.799
567.977	4191.877	2.878	568.060	4193.793	0.755
568.060	4191.877	2.656	568.143	4193.793	0.709
568.143	4191.877	2.430	568.227	4193.793	0.660
568.227	4191.877	2.205	568.310	4193.793	0.609
568.310	4191.877	1.981	564.560	4193.877	0.022
564.560	4191.960	0.012	564.643	4193.877	0.028
564.643	4191.960	0.013	564.727	4193.877	0.036
564.727	4191.960	0.015	564.810	4193.877	0.046
564.810	4191.960	0.016	564.893	4193.877	0.054
564.893	4191.960	0.018	564.977	4193.877	0.063
564.977	4191.960	0.020	565.060	4193.877	0.073
565.060	4191.960	0.022	565.143	4193.877	0.091
565.143	4191.960	0.023	565.227	4193.877	0.113
565.227	4191.960	0.025	565.310	4193.877	0.140
565.310	4191.960	0.028	565.393	4193.877	0.178
565.393	4191.960	0.031	565.477	4193.877	0.232
565.477	4191.960	0.035	565.560	4193.877	0.316
565.560	4191.960	0.040	565.643	4193.877	0.412
565.643	4191.960	0.046	565.727	4193.877	0.551
565.727	4191.960	0.053	565.810	4193.877	0.743
565.810	4191.960	0.061	565.893	4193.877	0.834
565.893	4191.960	0.073	565.977	4193.877	0.873
565.977	4191.960	0.089	566.060	4193.877	0.882
566.060	4191.960	0.107	566.143	4193.877	0.880
566.143	4191.960	0.134	566.227	4193.877	0.881
566.227	4191.960	0.166	566.310	4193.877	0.884
566.310	4191.960	0.213	566.393	4193.877	0.882
566.393	4191.960	0.223	566.477	4193.877	0.845
566.477	4191.960	0.263	566.560	4193.877	0.700
566.560	4191.960	0.335	566.643	4193.877	0.573
566.643	4191.960	0.472	566.727	4193.877	0.468
566.727	4191.960	0.598	566.810	4193.877	0.389
566.810	4191.960	0.685	566.893	4193.877	0.462
566.893	4191.960	0.713	566.977	4193.877	0.558
566.977	4191.960	0.705	567.060	4193.877	0.677
567.060	4191.960	0.676	567.143	4193.877	0.875
567.143	4191.960	0.671	567.227	4193.877	0.920
567.227	4191.960	0.665	567.310	4193.877	0.922
567.310	4191.960	0.662	567.393	4193.877	0.916
567.393	4191.960	0.701	567.477	4193.877	0.904
567.477	4191.960	0.777	567.560	4193.877	0.887
567.560	4191.960	0.972	567.643	4193.877	0.865
567.643	4191.960	0.860	567.727	4193.877	0.839
567.727	4191.960	0.763	567.810	4193.877	0.809

567.810	4191.960	0.680	567.893	4193.877	0.776
567.893	4191.960	1.314	567.977	4193.877	0.739
567.977	4191.960	2.889	568.060	4193.877	0.700
568.060	4191.960	2.700	568.143	4193.877	0.657
568.143	4191.960	2.463	568.227	4193.877	0.612
568.227	4191.960	2.231	568.310	4193.877	0.565
568.310	4191.960	2.000	564.560	4193.960	0.023
564.560	4192.043	0.012	564.643	4193.960	0.030
564.643	4192.043	0.014	564.727	4193.960	0.038
564.727	4192.043	0.015	564.810	4193.960	0.048
564.810	4192.043	0.016	564.893	4193.960	0.057
564.893	4192.043	0.018	564.977	4193.960	0.066
564.977	4192.043	0.020	565.060	4193.960	0.076
565.060	4192.043	0.022	565.143	4193.960	0.096
565.143	4192.043	0.024	565.227	4193.960	0.121
565.227	4192.043	0.026	565.310	4193.960	0.155
565.310	4192.043	0.029	565.393	4193.960	0.195
565.393	4192.043	0.032	565.477	4193.960	0.252
565.477	4192.043	0.037	565.560	4193.960	0.340
565.560	4192.043	0.042	565.643	4193.960	0.483
565.643	4192.043	0.049	565.727	4193.960	0.699
565.727	4192.043	0.058	565.810	4193.960	0.797
565.810	4192.043	0.069	565.893	4193.960	0.795
565.893	4192.043	0.086	565.977	4193.960	0.788
565.977	4192.043	0.110	566.060	4193.960	0.777
566.060	4192.043	0.141	566.143	4193.960	0.775
566.143	4192.043	0.183	566.227	4193.960	0.775
566.227	4192.043	0.235	566.310	4193.960	0.778
566.310	4192.043	0.308	566.393	4193.960	0.687
566.393	4192.043	0.331	566.477	4193.960	0.547
566.477	4192.043	0.428	566.560	4193.960	0.433
566.560	4192.043	0.620	566.643	4193.960	0.383
566.643	4192.043	0.870	566.727	4193.960	0.341
566.727	4192.043	1.031	566.810	4193.960	0.305
566.810	4192.043	1.079	566.893	4193.960	0.389
566.893	4192.043	1.039	566.977	4193.960	0.514
566.977	4192.043	0.961	567.060	4193.960	0.683
567.060	4192.043	0.871	567.143	4193.960	0.816
567.143	4192.043	0.834	567.227	4193.960	0.828
567.227	4192.043	0.806	567.310	4193.960	0.831
567.310	4192.043	0.785	567.393	4193.960	0.829
567.393	4192.043	0.798	567.477	4193.960	0.821
567.477	4192.043	0.840	567.560	4193.960	0.808
567.560	4192.043	0.947	567.643	4193.960	0.790
567.643	4192.043	1.077	567.727	4193.960	0.768
567.727	4192.043	1.306	567.810	4193.960	0.743
567.810	4192.043	1.734	567.893	4193.960	0.714
567.893	4192.043	2.914	567.977	4193.960	0.682
567.977	4192.043	2.957	568.060	4193.960	0.646
568.060	4192.043	2.714	568.143	4193.960	0.607
568.143	4192.043	2.472	568.227	4193.960	0.566
568.227	4192.043	2.236	568.310	4193.960	0.523
568.310	4192.043	2.002	564.560	4194.043	0.025
564.560	4192.127	0.012	564.643	4194.043	0.031
564.643	4192.127	0.014	564.727	4194.043	0.039
564.727	4192.127	0.015	564.810	4194.043	0.049
564.810	4192.127	0.017	564.893	4194.043	0.059
564.893	4192.127	0.018	564.977	4194.043	0.070

564.977	4192.127	0.021	565.060	4194.043	0.084
565.060	4192.127	0.023	565.143	4194.043	0.104
565.143	4192.127	0.025	565.227	4194.043	0.130
565.227	4192.127	0.027	565.310	4194.043	0.164
565.310	4192.127	0.029	565.393	4194.043	0.214
565.393	4192.127	0.033	565.477	4194.043	0.292
565.477	4192.127	0.038	565.560	4194.043	0.420
565.560	4192.127	0.043	565.643	4194.043	0.505
565.643	4192.127	0.052	565.727	4194.043	0.607
565.727	4192.127	0.063	565.810	4194.043	0.691
565.810	4192.127	0.077	565.893	4194.043	0.657
565.893	4192.127	0.100	565.977	4194.043	0.611
565.977	4192.127	0.136	566.060	4194.043	0.562
566.060	4192.127	0.188	566.143	4194.043	0.521
566.143	4192.127	0.261	566.227	4194.043	0.487
566.227	4192.127	0.364	566.310	4194.043	0.456
566.310	4192.127	0.499	566.393	4194.043	0.431
566.393	4192.127	0.534	566.477	4194.043	0.406
566.477	4192.127	0.776	566.560	4194.043	0.382
566.560	4192.127	1.404	566.643	4194.043	0.335
566.643	4192.127	1.847	566.727	4194.043	0.297
566.727	4192.127	1.909	566.810	4194.043	0.264
566.810	4192.127	1.734	566.893	4194.043	0.366
566.893	4192.127	1.505	566.977	4194.043	0.534
566.977	4192.127	1.286	567.060	4194.043	0.715
567.060	4192.127	1.099	567.143	4194.043	0.738
567.143	4192.127	1.015	567.227	4194.043	0.743
567.227	4192.127	0.956	567.310	4194.043	0.747
567.310	4192.127	0.915	567.393	4194.043	0.747
567.393	4192.127	0.895	567.477	4194.043	0.742
567.477	4192.127	0.896	567.560	4194.043	0.733
567.560	4192.127	0.929	567.643	4194.043	0.719
567.643	4192.127	1.371	567.727	4194.043	0.700
567.727	4192.127	2.959	567.810	4194.043	0.679
567.810	4192.127	3.530	567.893	4194.043	0.654
567.893	4192.127	3.229	567.977	4194.043	0.625
567.977	4192.127	2.953	568.060	4194.043	0.594
568.060	4192.127	2.696	568.143	4194.043	0.559
568.143	4192.127	2.454	568.227	4194.043	0.522
568.227	4192.127	2.217	568.310	4194.043	0.482
568.310	4192.127	1.984	568.460	4194.127	0.026
564.560	4192.210	0.012	564.643	4194.127	0.032
564.643	4192.210	0.013	564.727	4194.127	0.040
564.727	4192.210	0.015	564.810	4194.127	0.049
564.810	4192.210	0.016	564.893	4194.127	0.060
564.893	4192.210	0.018	564.977	4194.127	0.074
564.977	4192.210	0.021	565.060	4194.127	0.092
565.060	4192.210	0.023	565.143	4194.127	0.113
565.143	4192.210	0.025	565.227	4194.127	0.139
565.227	4192.210	0.027	565.310	4194.127	0.174
565.310	4192.210	0.029	565.393	4194.127	0.240
565.393	4192.210	0.033	565.477	4194.127	0.349
565.477	4192.210	0.038	565.560	4194.127	0.529
565.560	4192.210	0.044	565.643	4194.127	0.527
565.643	4192.210	0.054	565.727	4194.127	0.523
565.727	4192.210	0.067	565.810	4194.127	0.517
565.810	4192.210	0.084	565.893	4194.127	0.460
565.893	4192.210	0.115	565.977	4194.127	0.412

565.977	4192.210	0.166	566.060	4194.127	0.370
566.060	4192.210	0.248	566.143	4194.127	0.322
566.143	4192.210	0.378	566.227	4194.127	0.285
566.227	4192.210	0.605	566.310	4194.127	0.253
566.310	4192.210	1.005	566.393	4194.127	0.278
566.393	4192.210	1.092	566.477	4194.127	0.305
566.477	4192.210	1.654	566.560	4194.127	0.336
566.560	4192.210	4.455	566.643	4194.127	0.293
566.643	4192.210	4.617	566.727	4194.127	0.258
566.727	4192.210	3.634	566.810	4194.127	0.228
566.810	4192.210	2.703	566.893	4194.127	0.344
566.893	4192.210	2.086	566.977	4194.127	0.554
566.977	4192.210	1.645	567.060	4194.127	0.656
567.060	4192.210	1.330	567.143	4194.127	0.661
567.143	4192.210	1.193	567.227	4194.127	0.665
567.227	4192.210	1.104	567.310	4194.127	0.668
567.310	4192.210	1.044	567.393	4194.127	0.670
567.393	4192.210	0.982	567.477	4194.127	0.667
567.477	4192.210	0.936	567.560	4194.127	0.661
567.560	4192.210	0.906	567.643	4194.127	0.650
567.643	4192.210	1.799	567.727	4194.127	0.635
567.727	4192.210	3.808	567.810	4194.127	0.617
567.810	4192.210	3.481	567.893	4194.127	0.595
567.893	4192.210	3.175	567.977	4194.127	0.570
567.977	4192.210	2.899	568.060	4194.127	0.543
568.060	4192.210	2.641	568.143	4194.127	0.512
568.143	4192.210	2.406	568.227	4194.127	0.478
568.227	4192.210	2.174	568.310	4194.127	0.443
568.310	4192.210	1.946	564.560	4194.210	0.027
564.560	4192.293	0.012	564.643	4194.210	0.033
564.643	4192.293	0.013	564.727	4194.210	0.040
564.727	4192.293	0.015	564.810	4194.210	0.048
564.810	4192.293	0.016	564.893	4194.210	0.061
564.893	4192.293	0.018	564.977	4194.210	0.078
564.977	4192.293	0.020	565.060	4194.210	0.101
565.060	4192.293	0.022	565.143	4194.210	0.123
565.143	4192.293	0.024	565.227	4194.210	0.151
565.227	4192.293	0.027	565.310	4194.210	0.187
565.310	4192.293	0.029	565.393	4194.210	0.274
565.393	4192.293	0.033	565.477	4194.210	0.424
565.477	4192.293	0.038	565.560	4194.210	0.567
565.560	4192.293	0.045	565.643	4194.210	0.535
565.643	4192.293	0.054	565.727	4194.210	0.448
565.727	4192.293	0.067	565.810	4194.210	0.368
565.810	4192.293	0.085	565.893	4194.210	0.320
565.893	4192.293	0.117	565.977	4194.210	0.280
565.977	4192.293	0.167	566.060	4194.210	0.249
566.060	4192.293	0.250	566.143	4194.210	0.209
566.143	4192.293	0.398	566.227	4194.210	0.180
566.227	4192.293	0.690	566.310	4194.210	0.157
566.310	4192.293	1.364	566.393	4194.210	0.188
566.393	4192.293	2.036	566.477	4194.210	0.231
566.477	4192.293	2.488	566.560	4194.210	0.294
566.560	4192.293	17.917	566.643	4194.210	0.255
566.643	4192.293	10.141	566.727	4194.210	0.222
566.727	4192.293	6.025	566.810	4194.210	0.196
566.810	4192.293	3.945	566.893	4194.210	0.322
566.893	4192.293	2.750	566.977	4194.210	0.552

566.977	4192.293	2.029	567.060	4194.210	0.586
567.060	4192.293	1.561	567.143	4194.210	0.589
567.143	4192.293	1.406	567.227	4194.210	0.592
567.227	4192.293	1.322	567.310	4194.210	0.596
567.310	4192.293	1.293	567.393	4194.210	0.598
567.393	4192.293	1.305	567.477	4194.210	0.597
567.477	4192.293	1.394	567.560	4194.210	0.592
567.560	4192.293	1.562	567.643	4194.210	0.584
567.643	4192.293	3.594	567.727	4194.210	0.572
567.727	4192.293	3.692	567.810	4194.210	0.556
567.810	4192.293	3.362	567.893	4194.210	0.538
567.893	4192.293	3.069	567.977	4194.210	0.516
567.977	4192.293	2.804	568.060	4194.210	0.492
568.060	4192.293	2.559	568.143	4194.210	0.465
568.143	4192.293	2.329	568.227	4194.210	0.435
568.227	4192.293	2.106	568.310	4194.210	0.404
568.310	4192.293	1.886			
564.560	4192.377	0.012			

Appendix B

Wind Tunnel Data provided by Bruce White University of California, Davis

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Calibration of Hot Wire Probe

Calibrated By: Rachael Coquilla

Calibration Date: 2/21/01

Probe Model #: 1210-60

Probe Serial #: 005015

$R_o = 4.97 \text{ W}$

OHR = 1.5

$R_{on} = 7.455 \text{ W}$

Signal Conditioner Setting

$E_o = 1.823$ New Offset = 2

$E_m = 2.88$ New Gain = 5

Span = 9.4607 Check: -0.885 not < -5

Offset = 2.3515 4.4 not > 5

Gain = 9.4607

ambient pressure : 29.7 atm , 100575 Pa

ambient temperature : 23 deg C, 296.15 Kelvin

density of air : 1.244 kg/m³

density of water : 998 kg/m³

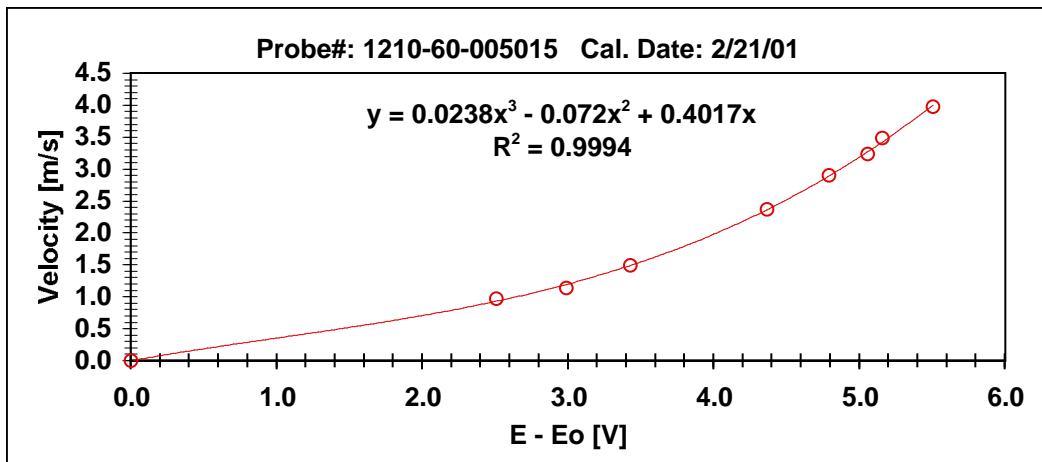
gravity : 9.807 m/s²

converting coeff, PSI to Pa : 6895

converting coeff, PSID to PSI : 0.932

converting coeff, in Oil to in Water : 0.934

motor [RPM]	micro-manometer		hot wire measurements			Percent Uncertainty
	[inch of Oil]	[m/s]	E	m/s	E-E _o	
0	0.0000	0.000	-1.014	0.000	0.000	0.00
325	0.0025	0.966	1.496	0.931	2.510	3.63
400	0.0035	1.143	1.973	1.192	2.987	4.26
500	0.0060	1.497	2.413	1.489	3.427	0.51
750	0.0150	2.366	3.350	2.360	4.364	0.27
900	0.0225	2.898	3.779	2.892	4.793	0.22
1000	0.0280	3.233	4.045	3.271	5.059	1.18
1050	0.0325	3.483	4.144	3.422	5.158	1.74
1200	0.0425	3.983	4.491	4.000	5.505	0.42



Calibration of Gas Analyzer (Rosemount Model 400A)

Calibration Date: 2/29/01

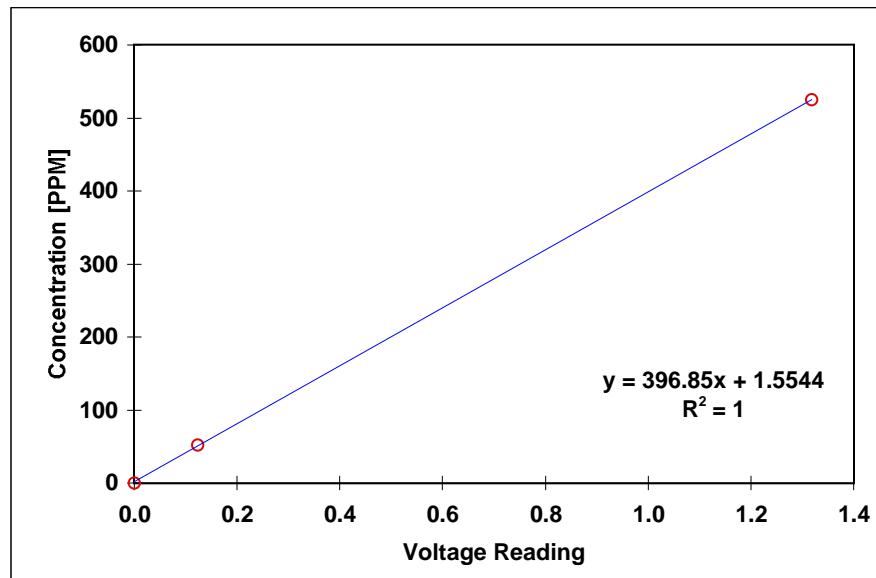
Calibrated By: Jim Phoremam

< DATA >

Ethane Concentration [PPM]	Voltage Reading [V]
0	0.0000
52.4	0.1238
524.8	1.3189

< RESULT >

$$\begin{aligned}C1 &= 396.85 \\C2 &= 1.5544\end{aligned}$$



Calibration of Flowmeter

Identification: **A-157-1**

Calibration Date: 2/7/01

Calibrated By: *Rachael Coquilla and Jim Phoremam*

Tygon Tube Length:

2.37 *m*

Ethane Concentration:

96.25 *%*

Ethane Regulator Pressure:

20 *psi*

< DATA >

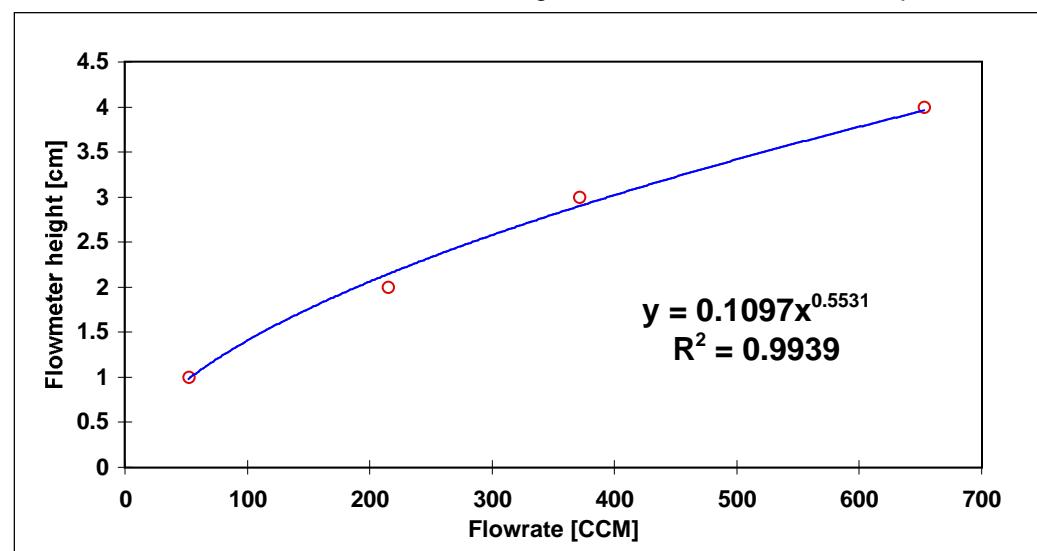
Volume of Tank [cm ³]	Height Reading [cm]	Average time to fill-up the Tank [second]	Estimated Flowrate [cm ³ /min]
100	1	114.97	52
100	2	27.86	215
100	3	16.16	371
100	4	9.19	653

< RESULT >

$$C1 = 0.1097$$

Flowrate to Flowmeter height

$$C2 = 0.5531$$



Original MET Data from LBNL Meteorological Tower

Wind Direction	Hours of occurrence per wind speed bin						Total hours per wind direction
	1-3 knots	4-6 knots	7-10 knots	11-16 knots	17-21 knots	>21 knots	
N	35	56	80	43	20	2	236
NNE	32	58	27	8	0	0	125
NE	26	36	27	7	0	0	96
ENE	33	47	42	50	25	26	223
E	59	105	88	74	31	55	412
ESE	73	200	197	171	54	23	718
SE	88	263	315	255	115	86	1122
SSE	61	198	229	92	20	10	610
S	41	149	176	59	10	5	440
SSW	39	117	149	26	3	1	335
SW	35	143	187	29	4	1	399
WSW	38	201	333	156	7	0	735
W	77	302	475	364	31	0	1249
WNW	87	280	401	193	34	11	1006
NW	105	196	162	118	17	1	599
NNW	59	115	114	116	41	4	449
Total hours per bin	888	2466	3002	1761	412	225	8754
							**
							Total Hours

Wind Direction	Frequency per wind speed bin						Total hours per wind direction
	1-3 knots	4-6 knots	7-10 knots	11-16 knots	17-21 knots	>21 knots	
N	0.40	0.64	0.91	0.49	0.23	0.02	2.70
NNE	0.37	0.66	0.31	0.09	0.00	0.00	1.43
NE	0.30	0.41	0.31	0.08	0.00	0.00	1.10
ENE	0.38	0.54	0.48	0.57	0.29	0.30	2.55
ENE	0.67	1.20	1.01	0.85	0.35	0.63	4.71
ESE	0.83	2.28	2.25	1.95	0.62	0.26	8.20
SE	1.01	3.00	3.60	2.91	1.31	0.98	12.82
SSE	0.70	2.26	2.62	1.05	0.23	0.11	6.97
S	0.47	1.70	2.01	0.67	0.11	0.06	5.03
SSW	0.45	1.34	1.70	0.30	0.03	0.01	3.83
SW	0.40	1.63	2.14	0.33	0.05	0.01	4.56
WSW	0.43	2.30	3.80	1.78	0.08	0.00	8.40
W	0.88	3.45	5.43	4.16	0.35	0.00	14.27
WNW	0.99	3.20	4.58	2.20	0.39	0.13	11.49
NW	1.20	2.24	1.85	1.35	0.19	0.01	6.84
NNW	0.67	1.31	1.30	1.33	0.47	0.05	5.13

Revised LBNL MET Data for Wind Tunnel Testing

Wind Direction	Hours of occurrence per wind speed bin				Total hours per wind direction	Frequency per speed and direction bin			
	3.5 knots	8.5 knots	13.5 knots	21 knots		3.5 knots	8.5 knots	13.5 knots	21 knots
N	91	80	43	22	236	0.386	0.339	0.182	0.093
NNE	90	27	8	0	125	0.720	0.216	0.064	0.000
NE	62	27	7	0	96	0.646	0.281	0.073	0.000
ENE	80	42	50	51	223	0.359	0.188	0.224	0.229
E	164	88	74	86	412	0.398	0.214	0.180	0.209
ESE	273	197	171	77	718	0.380	0.274	0.238	0.107
SE	351	315	255	201	1122	0.313	0.281	0.227	0.179
SSE	259	229	92	30	610	0.425	0.375	0.151	0.049
S	190	176	59	15	440	0.432	0.400	0.134	0.034
SSW	156	149	26	4	335	0.466	0.445	0.078	0.012
SW	178	187	29	5	399	0.446	0.469	0.073	0.013
WSW	239	333	156	7	735	0.325	0.453	0.212	0.010
W	379	475	364	31	1249	0.303	0.380	0.291	0.025
WNW	367	401	193	45	1006	0.365	0.399	0.192	0.045
NW	301	162	118	18	599	0.503	0.270	0.197	0.030
NNW	174	114	116	45	449	0.388	0.254	0.258	0.100
Total hours per bin	3354	3002	1761	637	8754				

Total Hours

Wind Direction	Percent frequency per speed bin				Total hours per wind direction
	3.5 knots	8.5 knots	13.5 knots	21 knots	
N	1.04	0.91	0.49	0.25	2.70
NNE	1.03	0.31	0.09	0.00	1.43
NE	0.71	0.31	0.08	0.00	1.10
ENE	0.91	0.48	0.57	0.58	2.55
E	1.87	1.01	0.85	0.98	4.71
ESE	3.12	2.25	1.95	0.88	8.20
SE	4.01	3.60	2.91	2.30	12.82
SSE	2.96	2.62	1.05	0.34	6.97
S	2.17	2.01	0.67	0.17	5.03
SSW	1.78	1.70	0.30	0.05	3.83
SW	2.03	2.14	0.33	0.06	4.56
WSW	2.73	3.80	1.78	0.08	8.40
W	4.33	5.43	4.16	0.35	14.27
WNW	4.19	4.58	2.20	0.51	11.49
NW	3.44	1.85	1.35	0.21	6.84
NNW	1.99	1.30	1.33	0.51	5.13

Exhaust Stack Plan ID: Bldg 75 Stack

Modeling variables

Geometric scaling factor :		1" = 66.67 '	= 800 "
		Full Scale	Wind-tunnel Scale
Stack	Stack Height	15 ft	0.22 inch
	Roof Height	16 ft	0.24 inch
	Inner Dia.	1.8806 ft	0.0282 inch
	Internal Area	2.78 ft ²	0.0040 cm ²
	Flowrate	6500 CFM	varies (see following table)
	Flowspeed, V _s	11.89 m/s	varies (see following table)
Wind	Horizontal speed, U _m at MET tower site	varies (see following table) 20 m	varies (see following table) 2.50 cm
	Horizontal speed, U _s at stack site	varies (see following table) 9.45 m	varies (see following table) 1.18 cm
	Speed ratio, U _s /U _m	varies (see following table)	varies (see following table)

Horizontal wind speed, U _m , at full scale LBNL MET tower site				
knots	[MPH]	ft/s	[m/s]	[cm/min]
3.5	4	5.91	1.80	10803
8.5	10	14.35	4.37	26237
13.5	16	22.79	6.94	41670
21	24	35.44	10.80	64820

Flowmeter calibration used for test: A-157-1 96.25%
 Flowmeter calibration coefficients: C1 = 0.1097
 C2 = 0.5531

Wind Direction	Measured Wind Tunnel Speeds			Speed Ratio U _s /U _m
	Freestream U _{ref} [m/s]	MET Site U _m [m/s]	Stack Site U _s [m/s]	
Max Cu	3.843	2.026	0.623	0.31
WNW	3.845	2.085	0.844	0.40
W	4.049	1.870	1.678	0.90
WSW	3.914	2.316	2.098	0.91
SW	3.819	1.665	1.767	1.06
SSW	3.907	1.578	1.678	1.06
S	3.761	0.963	1.210	1.26
SSE	3.782	1.135	0.780	0.69
SE	3.711	1.488	0.714	0.48
ESE	3.703	1.850	0.706	0.38
E	3.831	1.956	0.740	0.38
ENE	3.765	0.654	0.942	1.44
NE	3.895	0.683	0.627	0.92
NNE	3.916	0.667	0.572	0.86
N	3.857	1.206	0.564	0.47
NNW	3.863	1.528	0.553	0.36
NW	3.750	2.025	0.485	0.24

Wind Direction	Model Stack Calculated & Simulated Parameters								Simulated Stack Site Speed Ratio V _s /U _s	Simulated Wind speed at F.S. stack U _s [m/s]	Simulated Wind speed at MET site, U _m [m/s]	Simulated Wind speed at MET site, U _m [knots]	Percent deviation of F.S. MET U _m
	Wind speed at F.S. stack U _s [m/s]	Stack Site Speed Ratio V _s /U _s	Calculated Flowspeed V _s [m/s]	Calculated Flowrate Q [CCM]	Calculated Height [cm]	Flowmeter Height [cm]	Simulated Flowrate [CCM]	Simulated Flowspeed V _s [m/s]					
Max Cu	0.55	21.47	13.38	324	2.68	2.75	339	13.99	22.46	0.53	1.72	3.3	4.42
	1.34	8.84	5.51	133	1.64	1.75	150	6.18	9.92	1.20	3.90	7.6	10.89
	2.14	5.57	3.47	84	1.27	1.25	81	3.36	5.40	2.20	7.16	13.9	3.08
	3.32	3.58	2.23	54	1.00	1.00	54	2.25	3.61	3.30	10.72	20.8	0.80
WNW	0.73	16.31	13.77	333	2.72	2.75	339	13.99	16.58	0.72	1.77	3.4	1.64
	1.77	6.72	5.67	137	1.67	1.75	150	6.18	7.32	1.62	4.01	7.8	8.30
	2.81	4.23	3.57	86	1.29	1.25	81	3.36	3.99	2.98	7.37	14.3	6.09
	4.37	2.72	2.29	55	1.01	1.00	54	2.25	2.66	4.46	11.03	21.4	2.09
W	1.62	7.36	12.35	299	2.57	2.50	285	11.78	7.02	1.69	1.89	3.7	4.81
	3.92	3.03	5.08	123	1.57	1.50	113	4.68	2.79	4.26	4.75	9.2	8.68
	6.23	1.91	3.20	77	1.22	1.25	81	3.36	2.00	5.93	6.61	12.8	4.85
	9.69	1.23	2.06	50	0.95	1.00	54	2.25	1.34	8.88	9.89	19.2	8.44
WSW	1.63	7.29	15.29	370	2.89	2.75	339	13.99	6.67	1.78	1.97	3.8	9.26
	3.96	3.00	6.30	152	1.77	1.75	150	6.18	2.95	4.03	4.45	8.7	1.86
	6.29	1.89	3.96	96	1.37	1.25	81	3.36	1.60	7.41	8.18	15.9	17.84
	9.79	1.21	2.55	62	1.07	1.00	54	2.25	1.07	11.10	12.25	23.8	13.40
SW	1.91	6.22	10.99	266	2.41	2.50	285	11.78	6.67	1.78	1.68	3.3	6.68
	4.64	2.56	4.53	109	1.47	1.50	113	4.68	2.65	4.49	4.23	8.2	3.23
	7.37	1.61	2.85	69	1.14	1.25	81	3.36	1.90	6.24	5.88	11.4	15.28
	11.47	1.04	1.83	44	0.89	0.75	32	1.34	0.76	15.72	14.82	28.8	37.15
SSW	1.91	6.21	10.42	252	2.34	2.25	236	9.74	5.80	2.05	1.93	3.7	7.00
	4.65	2.56	4.29	104	1.43	1.50	113	4.68	2.79	4.26	4.01	7.8	8.29
	7.39	1.61	2.70	65	1.11	1.00	54	2.25	1.34	8.88	8.35	16.2	20.19
	11.49	1.03	1.74	42	0.87	0.75	32	1.34	0.80	14.93	14.04	27.3	29.98
S	2.26	5.25	6.36	154	1.78	1.75	150	6.18	5.11	2.33	1.85	3.6	2.86
	5.49	2.16	2.62	63	1.09	1.00	54	2.25	1.86	6.40	5.09	9.9	16.49
	8.73	1.36	1.65	40	0.84	0.75	32	1.34	1.10	10.77	8.57	16.7	23.39
	13.57	0.88	1.06	26	0.66	0.50	16	0.64	0.53	22.41	17.84	34.7	65.11
SSE	1.24	9.61	7.49	181	1.95	2.00	190	7.87	10.09	1.18	1.71	3.3	4.77
	3.01	3.96	3.09	75	1.19	1.25	81	3.36	4.31	2.76	4.01	7.8	8.28
	4.77	2.49	1.94	47	0.92	1.00	54	2.25	2.88	4.13	6.00	11.7	13.55
	7.42	1.60	1.25	30	0.72	0.75	32	1.34	1.71	6.94	10.10	19.6	6.51
SE	0.86	13.76	9.82	238	2.26	2.25	236	9.74	13.64	0.87	1.82	3.5	0.90
	2.10	5.67	4.05	98	1.38	1.50	113	4.68	6.55	1.81	3.78	7.4	13.52
	3.33	3.57	2.55	62	1.07	1.00	54	2.25	3.15	3.78	7.87	15.3	13.34
	5.18	2.29	1.64	40	0.84	0.75	32	1.34	1.87	6.35	13.24	25.7	22.57
ESE	0.69	17.30	12.21	295	2.55	2.50	285	11.78	16.68	0.71	1.87	3.6	3.69
	1.67	7.12	5.03	122	1.56	1.50	113	4.68	6.63	1.79	4.70	9.1	7.52
	2.65	4.49	3.17	77	1.21	1.25	81	3.36	4.77	2.49	6.54	12.7	5.87
	4.12	2.88	2.04	49	0.95	1.00	54	2.25	3.18	3.73	9.79	19.0	9.42
E	0.68	17.45	12.91	312	2.63	2.75	339	13.99	18.91	0.63	1.66	3.2	7.72
	1.65	7.19	5.32	129	1.61	1.50	113	4.68	6.32	1.88	4.97	9.7	13.68
	2.63	4.52	3.35	81	1.25	1.25	81	3.36	4.55	2.61	6.91	13.4	0.48
	4.09	2.91	2.15	52	0.98	1.00	54	2.25	3.04	3.91	10.35	20.1	4.23
ENE	2.59	4.58	4.32	104	1.44	1.50	113	4.68	4.97	2.39	1.66	3.2	7.69

Wind Direction	Model Stack Calculated & Simulated Parameters								Simulated Stack Site Speed Ratio V_s/U_s	Simulated Wind speed at F.S. stack U_s [m/s]	Simulated Wind speed at MET site, U_m [m/s]	Simulated Wind speed at MET site, U_m [knots]	Percent deviation of F.S. MET U_m
	Wind speed at F.S. stack U_s [m/s]	Stack Site Speed Ratio V_s/U_s	Calculated Flowspeed V_s [m/s]	Calculated Flowrate Q [CCM]	Calculated Height [cm]	Flowmeter Height [cm]	Simulated Flowrate [CCM]	Simulated Flowspeed V_s [m/s]					
			1.78	43	0.88		1.00	54					
	6.30	1.89	1.78	43	0.88	1.00	54	2.25	2.39	4.98	3.46	6.7	20.89
	10.00	1.19	1.12	27	0.68	0.75	32	1.34	1.42	8.38	5.82	11.3	16.20
	15.56	0.76	0.72	17	0.53	0.50	16	0.64	0.68	17.45	12.11	23.5	12.13
NE	1.65	7.19	4.51	109	1.47	1.50	113	4.68	7.46	1.59	1.74	3.4	3.60
	4.01	2.96	1.86	45	0.90	1.00	54	2.25	3.58	3.32	3.61	7.0	17.38
	6.38	1.86	1.17	28	0.70	0.75	32	1.34	2.13	5.58	6.08	11.8	12.49
	9.92	1.20	0.75	18	0.55	0.50	16	0.64	1.02	11.61	12.65	24.6	17.10
NNE	1.54	7.70	4.40	107	1.45	1.25	81	3.36	5.88	2.02	2.36	4.6	30.90
	3.75	3.17	1.81	44	0.89	1.00	54	2.25	3.93	3.03	3.53	6.9	19.31
	5.96	2.00	1.14	28	0.69	0.75	32	1.34	2.34	5.09	5.94	11.5	14.54
	9.26	1.28	0.73	18	0.54	0.50	16	0.64	1.12	10.59	12.35	24.0	14.36
N	0.84	14.12	7.96	193	2.01	1.25	81	3.36	5.96	1.99	4.26	8.3	136.68
	2.04	5.81	3.28	79	1.23	1.00	54	2.25	3.98	2.98	6.38	12.4	45.89
	3.25	3.66	2.06	50	0.95	0.75	32	1.34	2.37	5.02	10.73	20.9	54.53
	5.05	2.35	1.33	32	0.75	0.50	16	0.64	1.14	10.45	22.34	43.4	106.77
NNW	0.65	18.24	10.09	244	2.29	2.25	236	9.74	17.26	0.69	1.90	3.7	5.67
	1.58	7.51	4.15	100	1.40	1.50	113	4.68	8.29	1.43	3.96	7.7	9.43
	2.51	4.73	2.62	63	1.09	1.00	54	2.25	3.98	2.98	8.24	16.0	18.70
	3.91	3.04	1.68	41	0.85	0.75	32	1.34	2.37	5.02	13.87	27.0	28.36
NW	0.43	27.57	13.37	323	2.68	2.75	339	13.99	24.81	0.48	2.00	3.9	11.09
	1.05	11.35	5.51	133	1.64	1.75	150	6.18	10.96	1.08	4.53	8.8	3.57
	1.66	7.15	3.47	84	1.27	1.25	81	3.36	5.96	1.99	8.32	16.2	19.82
	2.59	4.59	2.23	54	1.00	1.00	54	2.25	3.98	2.98	12.46	24.2	15.30

Measured Concentrations from Wind Tunnel Testing

Wind Direction	Receptor Number	Measured concentrations at each flowmeter height setting [cm]				Background Concentration	Ethane %
Max Cu	30	1.00 19.43	1.25 24.52	1.75 66.73	2.75 153.10	2.17	96.25
WNW	30	1.00 31.40	1.25 41.86	1.75 65.76	2.75 180.27	1.65	96.25
	15	220.43	176.88	173.92	123.51	1.65	96.25
	20	30.03	39.36	61.28	114.54	1.65	96.25
	19	7.55	11.65	19.16	35.42	1.65	96.25
	24	21.23	28.65	46.09	84.91	1.65	96.25
	14	2.23	2.36	2.88	3.34	1.65	96.25
W	15	1.00 132.40	1.25 143.38	1.50 116.69	2.50 75.35	1.62	96.25
	30	29.55	40.11	63.26	116.11	1.62	96.25
	14	4.49	4.38	4.66	7.14	1.62	96.25
	13	4.73	6.06	6.34	11.66	1.62	96.25
	19	34.20	56.17	63.61	117.00	1.62	96.25
	12	2.26	2.29	2.51	2.95	1.62	96.25
WSW	15	1.00 19.19	1.25 23.41	1.75 32.51	2.75 51.23	0.04	96.25
	14	197.37	308.68	549.75	985.40	0.04	96.25
	13	22.94	28.37	57.39	114.00	0.04	96.25
	12	17.93	24.76	32.89	78.30	0.04	96.25
	7	14.92	17.64	26.47	35.60	0.04	96.25
SW	15	0.75 1.45	1.25 1.58	1.50 1.72	2.50 1.89	0.88	96.25
	8	20.89	44.24	53.02	78.22	0.88	96.25
	7	12.66	32.92	44.89	77.35	0.88	96.25
	2	7.91	15.07	15.88	27.53	0.88	96.25
	3	7.27	11.94	13.44	22.51	0.88	96.25
SSW	15	0.75 0.58	1.00 0.81	1.50 0.95	2.25 0.80	0.44	96.25
	8	33.70	53.09	86.36	143.11	0.44	96.25
	3	15.36	28.39	39.82	64.38	0.44	96.25
	2	13.17	22.13	35.87	66.37	0.44	96.25
	7	5.02	5.58	12.76	19.61	0.44	96.25
S	15	0.50 1.57	0.75 2.29	1.00 2.68	1.75 2.52	1.18	96.25
	9	7.35	26.73	40.60	69.73	1.18	96.25
	4	2.92	3.44	4.85	8.19	1.18	96.25
	3	14.81	25.17	44.35	84.20	1.18	96.25
	1	2.24	3.02	3.66	6.34	1.18	96.25
	8	6.59	14.59	22.11	31.84	1.18	96.25

Wind Direction	Receptor Number	Measured concentrations at each flowmeter height setting [cm]				Background Concentration	Ethane %
		0.75	1.00	1.25	2.00		
SSE	15	46.43	50.92	77.44	91.54	0.90	96.25
	9	45.33	65.75	94.59	179.01	0.90	96.25
	4	22.75	32.49	43.47	86.37	0.90	96.25
	1	13.30	24.66	27.07	52.65	0.90	96.25
	5	1.84	2.18	2.30	3.54	0.90	96.25
SE		0.75	1.00	1.50	2.25		
	10	17.86	33.07	62.76	134.58	0.60	96.25
	5	11.32	21.96	35.73	53.81	0.60	96.25
	6	1.16	1.58	2.10	2.16	0.60	96.25
	9	27.70	44.71	70.66	109.39	0.60	96.25
	4	5.49	10.10	15.87	19.38	0.60	96.25
ESE	15	64.90	127.17	212.12	355.31	0.60	96.25
		1.00	1.25	1.50	2.50		
	15	48.57	61.42	92.57	295.19	2.74	96.25
	10	14.05	19.52	29.02	100.60	2.74	96.25
	11	4.93	5.34	7.52	16.82	2.74	96.25
	6	12.91	14.39	19.61	49.42	2.74	96.25
	5	24.09	23.60	29.09	56.02	2.74	96.25
	16	2.76	2.76	2.76	10.50	2.74	96.25
	14	27.29	27.20	24.15	29.43	2.74	96.25
E	9	42.71	60.73	63.36	148.31	2.74	96.25
	4	17.44	21.92	23.87	39.70	2.74	96.25
		1.00	1.25	1.50	2.75		
	15	1.48	2.24	2.50	60.81	1.00	96.25
	16	1.04	1.20	1.38	2.65	1.00	96.25
	17	2.39	3.09	3.21	4.16	1.00	96.25
	18	2.15	2.04	2.22	2.32	1.00	96.25
	11	5.30	7.55	8.13	20.13	1.00	96.25
	10	11.68	16.20	22.08	83.29	1.00	96.25
	9	18.27	27.80	39.14	142.80	1.00	96.25
ENE	3	10.26	10.56	13.64	32.72	1.00	96.25
	14	333.33	381.84	432.53	505.35	1.00	96.25
	30	17.92	22.07	25.11	34.32	1.00	96.25
	6	3.59	4.13	4.57	10.18	1.00	96.25
		0.50	0.75	1.00	1.50		
	15	5.46	8.29	12.72	19.29	3.00	96.25
	14	124.63	223.48	350.69	535.90	3.00	96.25
	30	42.37	77.56	94.74	71.45	3.00	96.25
	20	5.53	6.39	9.36	12.70	3.00	96.25
	21	4.21	5.57	6.97	8.95	3.00	96.25
	22	4.48	5.74	7.89	9.85	3.00	96.25
	23	4.30	5.70	7.57	11.63	3.00	96.25
	16	6.51	8.53	11.48	22.30	3.00	96.25
	17	5.78	6.96	8.16	13.18	3.00	96.25
	18	5.37	6.46	8.30	12.40	3.00	96.25
	9	4.95	5.38	7.64	10.92	3.00	96.25

Wind Direction	Receptor Number	Measured concentrations at each flowmeter height setting [cm]				Background Concentration	Ethane %
		0.50	0.75	1.00	1.50		
NE	15	12.30	19.50	27.34	64.70	5.27	96.25
	14	163.04	291.05	365.17	411.99	5.27	96.25
	30	55.05	93.07	127.72	205.19	5.27	96.25
	21	11.05	15.73	21.47	35.26	5.27	96.25
	22	11.27	15.36	22.14	37.04	5.27	96.25
	23	8.86	12.81	15.15	22.95	5.27	96.25
NNE		0.50	0.75	1.00	1.25		
	15	8.64	19.82	26.70	51.94	4.99	96.25
	21	10.57	14.57	24.21	33.49	4.99	96.25
	22	8.46	11.95	15.66	20.39	4.99	96.25
	27	7.58	9.84	13.22	15.65	4.99	96.25
	28	7.25	8.85	11.33	13.91	4.99	96.25
	14	147.07	229.64	302.45	368.63	4.99	96.25
	30	24.48	47.77	64.19	126.15	4.99	96.25
	20	7.71	10.53	12.01	21.03	4.99	96.25
	9	7.16	9.55	12.88	13.66	4.99	96.25
	8	30.59	34.18	71.15	93.10	4.99	96.25
	26	6.94	7.90	10.38	14.54	4.99	96.25
	16	6.08	8.18	8.59	10.76	4.99	96.25
N		0.50	0.75	1.00	1.25		
	15	11.87	13.71	23.40	34.37	2.34	96.25
	14	64.12	89.14	149.09	212.98	2.34	96.25
	30	41.40	70.79	98.46	152.79	2.34	96.25
	21	8.78	14.05	26.16	35.17	2.34	96.25
	26	6.66	9.15	14.58	18.38	2.34	96.25
	27	4.10	5.09	7.97	11.52	2.34	96.25
	29	4.40	6.82	8.94	12.12	2.34	96.25
	20	4.93	5.57	9.82	13.64	2.34	96.25
NNW		0.75	1.00	1.50	2.25		
	15	39.79	53.96	57.91	83.01	5.22	96.25
	14	55.54	74.97	112.55	164.75	5.22	96.25
	30	59.88	105.41	201.22	336.12	5.22	96.25
	20	16.91	29.46	55.55	95.60	5.22	96.25
	21	8.44	10.37	15.92	18.77	5.22	96.25
	25	17.29	24.94	44.78	67.96	5.22	96.25
	26	14.38	19.27	31.07	39.38	5.22	96.25
	29	8.16	10.36	15.22	24.40	5.22	96.25
	19	8.55	11.14	12.83	17.31	5.22	96.25
NW		1.00	1.25	1.75	2.75		
	15	90.80	96.13	139.63	152.89	6.00	96.25
	14	27.75	33.99	38.53	44.66	6.00	96.25
	30	75.70	142.22	226.82	354.86	6.00	96.25
	20	65.81	102.33	163.67	324.51	6.00	96.25
	25	25.01	38.42	56.18	102.16	6.00	96.25
	24	26.24	31.24	48.63	76.85	6.00	96.25
	26	10.00	20.00	30.00	27.00	6.00	96.25

Dilution Factors & Resulting Full Scale Concentrations

								Presumed emission per year =	30 Ci/yr		
								Resulting hourly emission rate =	3.42E+09 pCi/hr		
								Total emission rate of full scale stack =	6500 CFM		
								=	11043.57 m ³ /hr		
Emissions per volume of total stack emission = 3.10E+05 pCi/m ³											
Wind Direction	Receptor Number	Dilution factors for each designated LBNL MET site wind speed bin				F.S. concentrations [pCi/m ³] accumulated from each LBNL MET site wind speed bin				Total concentration per wind direction [pCi/m ³]	Annual concentration [pCi/m ³]
		3.5 knots	8.5 knots	13.5 knots	21 knots	3.5 knots	8.5 knots	13.5 knots	21 knots		
Max Cu	30	55765	43065	14909	6377	1.687	2.739	6.062	1.207	11.695	1.344
WNW	30	32353	23937	15013	5389	3.497	5.164	3.963	2.574	15.198	1.747
WNW	15	4399	5493	5587	7898	25.715	22.504	10.648	1.756	60.623	6.967
WNW	20	33915	25524	16141	8526	3.336	4.843	3.686	1.627	13.491	1.550
WNW	19	163136	96250	54969	28502	0.693	1.284	1.082	0.487	3.547	0.408
WNW	24	49157	35648	21658	11560	2.301	3.468	2.747	1.200	9.716	1.117
WNW	14	1659483	1355634	782520	569527	0.068	0.091	0.076	0.024	0.260	0.030
W	15	7360	6790	8364	13054	12.786	17.370	10.805	0.590	41.550	5.928
W	30	34461	25006	15615	8407	2.731	4.716	5.788	0.916	14.150	2.019
W	14	335366	348732	316612	174366	0.281	0.338	0.285	0.044	0.948	0.135
W	13	309486	216779	203919	95867	0.304	0.544	0.443	0.080	1.372	0.196
W	19	29543	17644	15527	8342	3.185	6.684	5.821	0.923	16.612	2.370
W	12	1503906	1436567	1081461	723684	0.063	0.082	0.084	0.011	0.239	0.034
WSW	15	50261	41185	29643	18803	2.006	3.411	2.220	0.157	7.795	0.654
WSW	14	4878	3119	1751	977	20.673	45.052	37.590	3.024	106.340	8.928
WSW	13	42031	33975	16783	8446	2.399	4.135	3.922	0.350	10.806	0.907
WSW	12	53801	38936	29300	12299	1.874	3.608	2.246	0.240	7.969	0.669
WSW	7	64684	54688	36417	27067	1.559	2.569	1.807	0.109	6.044	0.508
SW	15	1688596	1375000	1145833	952970	0.082	0.106	0.020	0.004	0.211	0.010
SW	8	48101	22198	18460	12445	2.876	6.547	1.221	0.312	10.957	0.499
SW	7	81706	30041	21870	12587	1.693	4.838	1.031	0.309	7.871	0.359
SW	2	136913	67829	64167	36116	1.010	2.143	0.351	0.108	3.612	0.165
SW	3	150626	87025	76632	44498	0.918	1.670	0.294	0.087	2.970	0.135
SSW	15	6875000	2601351	1887255	2673611	0.021	0.053	0.013	0.001	0.088	0.003
SSW	8	28939	18281	11202	6746	4.990	7.545	2.148	0.549	15.232	0.583
SSW	3	64511	34436	24441	15053	2.238	4.005	0.985	0.246	7.474	0.286
SSW	2	75609	44375	27166	14599	1.910	3.108	0.886	0.254	6.158	0.236
SSW	7	210153	187257	78125	50209	0.687	0.737	0.308	0.074	1.806	0.069
S	15	2467949	867117	641667	718284	0.054	0.143	0.065	0.015	0.277	0.014
S	9	155997	37671	24417	14041	0.858	3.293	1.703	0.753	6.607	0.332
S	4	553161	425885	262262	137304	0.242	0.291	0.159	0.077	0.769	0.039
S	3	70616	40121	22296	11594	1.896	3.092	1.865	0.912	7.765	0.390
S	1	908019	523098	388105	186531	0.147	0.237	0.107	0.057	0.548	0.028
S	8	177911	71775	45987	31393	0.753	1.728	0.904	0.337	3.722	0.187
SSE	15	21140	19242	12575	10619	6.228	6.050	3.719	1.436	17.434	1.215
SSE	9	21663	14842	10273	5404	6.078	7.844	4.553	2.822	21.296	1.484
SSE	4	44050	30469	22610	11261	2.989	3.821	2.069	1.354	10.233	0.713
SSE	1	77621	40509	36779	18599	1.696	2.874	1.272	0.820	6.662	0.464
SSE	5	1023936	751953	687500	364583	0.129	0.155	0.068	0.042	0.393	0.027
SE	10	55765	29643	15484	7184	1.740	2.937	4.552	7.733	16.961	2.174
SE	5	89785	45061	27398	18089	1.080	1.932	2.572	3.071	8.656	1.109
SE	6	1718750	982143	641667	616987	0.056	0.089	0.110	0.090	0.345	0.044
SE	9	35517	21820	13738	8847	2.731	3.990	5.130	6.279	18.131	2.324
SE	4	196830	101316	63032	51251	0.493	0.859	1.118	1.084	3.554	0.456
SE	15	14969	7604	4550	2713	6.481	11.449	15.488	20.473	53.891	6.907
ESE	15	21002	16403	10715	3291	5.614	5.187	6.893	10.105	27.799	2.280
ESE	10	85102	57360	36625	9835	1.386	1.483	2.017	3.381	8.267	0.678
ESE	11	439498	370192	201360	68359	0.268	0.230	0.367	0.486	1.351	0.111
ESE	6	94641	82618	57054	20619	1.246	1.030	1.294	1.613	5.183	0.425
ESE	5	45082	46141	36528	18065	2.615	1.844	2.022	1.841	8.322	0.683
ESE	16	48125000	48125000	48125000	124034	0.002	0.002	0.002	0.268	0.274	0.022
ESE	14	39206	39350	44956	36062	3.007	2.162	1.643	0.922	7.735	0.634
ESE	9	24081	16598	15878	6612	4.896	5.126	4.652	5.030	19.704	1.616
ESE	4	65476	50182	45551	26042	1.801	1.695	1.621	1.277	6.395	0.524
E	15	2005208	776210	641667	16093	0.062	0.085	0.087	4.022	4.256	0.200
E	16	24062500	4812500	2532895	583333	0.005	0.014	0.022	0.111	0.152	0.007
E	17	692446	460526	435520	304589	0.178	0.144	0.128	0.213	0.662	0.031
E	18	836957	925481	788934	729167	0.147	0.072	0.071	0.089	0.378	0.018
E	11	223837	146947	134993	50314	0.551	0.451	0.413	1.287	2.701	0.127

Wind Direction	Receptor Number	Dilution factors for each designated LBNL MET site wind speed bin				F.S. concentrations [pCi/m³] accumulated from each LBNL MET site wind speed bin				Total concentration per wind direction [pCi/m³]	Annual concentration [pCi/m³]
		3.5 knots	8.5 knots	13.5 knots	21 knots	3.5 knots	8.5 knots	13.5 knots	21 knots		
- B.13 -											
E	10	90122	63322	45659	11696	1.370	1.046	1.220	5.534	9.170	0.432
E	9	55732	35914	25236	6788	2.215	1.844	2.207	9.536	15.803	0.744
E	3	103942	100680	76147	30344	1.188	0.658	0.731	2.133	4.710	0.222
E	14	2896	2527	2230	1908	42.621	26.208	24.972	33.919	127.720	6.011
E	30	56885	45681	39921	28887	2.170	1.450	1.395	2.241	7.256	0.341
E	6	371622	307508	269608	104847	0.332	0.215	0.207	0.617	1.372	0.065
ENE	15	391260	181947	99023	59085	0.284	0.321	0.702	1.200	2.508	0.064
ENE	14	7913	4365	2768	1806	14.058	13.379	25.117	39.266	91.820	2.339
ENE	30	24448	12909	10492	14061	4.550	4.524	6.627	5.044	20.746	0.528
ENE	20	380435	283923	151336	99227	0.292	0.206	0.459	0.715	1.672	0.043
ENE	21	795455	374514	242443	161765	0.140	0.156	0.287	0.438	1.021	0.026
ENE	22	650338	351277	196830	140511	0.171	0.166	0.353	0.505	1.195	0.030
ENE	23	740385	356481	210613	111530	0.150	0.164	0.330	0.636	1.280	0.033
ENE	16	274217	174051	113502	49870	0.406	0.336	0.613	1.422	2.776	0.071
ENE	17	346223	243056	186531	94548	0.321	0.240	0.373	0.750	1.684	0.043
ENE	18	406118	278179	181604	102394	0.274	0.210	0.383	0.693	1.559	0.040
ENE	9	493590	404412	207435	121528	0.225	0.144	0.335	0.584	1.289	0.033
NE	15	136913	67639	43611	16196	1.463	1.289	0.518	0.000	3.271	0.036
NE	14	6101	3368	2674	2366	32.829	25.896	8.455	0.000	67.180	0.737
NE	30	19335	10962	7860	4814	10.358	7.956	2.877	0.000	21.191	0.232
NE	21	166522	92017	59414	32094	1.203	0.948	0.381	0.000	2.531	0.028
NE	22	160417	95391	57054	30296	1.248	0.914	0.396	0.000	2.559	0.028
NE	23	268106	127653	97419	54440	0.747	0.683	0.232	0.000	1.662	0.018
NNE	15	263699	64902	44334	20501	0.847	1.032	0.448	0.000	2.326	0.033
NNE	21	172491	100470	50078	33772	1.294	0.667	0.396	0.000	2.357	0.034
NNE	22	277378	138290	90206	62500	0.805	0.484	0.220	0.000	1.509	0.022
NNE	27	371622	198454	116950	90291	0.601	0.338	0.170	0.000	1.108	0.016
NNE	28	425885	249352	151814	107904	0.524	0.269	0.131	0.000	0.924	0.013
NNE	14	6774	4284	3236	2647	32.959	15.634	6.134	0.000	54.726	0.781
NNE	30	49384	22499	16258	7944	4.521	2.977	1.221	0.000	8.719	0.125
NNE	20	353860	173736	137108	60006	0.631	0.386	0.145	0.000	1.161	0.017
NNE	9	443548	211075	121990	111015	0.503	0.317	0.163	0.000	0.983	0.014
NNE	8	37598	32974	14548	10924	5.939	2.031	1.364	0.000	9.334	0.133
NNE	26	493590	330756	178571	100785	0.452	0.203	0.111	0.000	0.766	0.011
NNE	16	883028	301724	267361	166811	0.253	0.222	0.074	0.000	0.549	0.008
N	15	100997	84653	45703	30050	1.184	1.242	1.236	0.962	4.624	0.125
N	14	15579	11089	6559	4569	7.675	9.480	8.615	6.326	32.096	0.865
N	30	24642	14061	10014	6397	4.853	7.476	5.643	4.519	22.490	0.606
N	21	149457	82195	40407	29318	0.800	1.279	1.398	0.986	4.463	0.120
N	26	222801	141336	78636	60006	0.537	0.744	0.719	0.482	2.481	0.067
N	27	546875	350000	170959	104847	0.219	0.300	0.331	0.276	1.125	0.030
N	29	467233	214844	145833	98415	0.256	0.489	0.387	0.294	1.426	0.038
N	20	371622	297988	128676	85177	0.322	0.353	0.439	0.339	1.453	0.039
N	8	474138	488579	154247	149689	0.252	0.215	0.366	0.193	1.027	0.028
NNW	15	27842	19748	18267	12373	4.316	3.987	4.386	2.512	15.201	0.780
NNW	14	19128	13799	8968	6033	6.283	5.706	8.934	5.151	26.074	1.337
NNW	30	17610	9607	4911	2909	6.824	8.196	16.315	10.685	42.019	2.155
NNW	20	82335	39707	19124	10649	1.460	1.983	4.189	2.918	10.550	0.541
NNW	21	298913	186893	89953	71033	0.402	0.421	0.891	0.438	2.151	0.110
NNW	25	79743	48808	24330	15341	1.507	1.613	3.293	2.026	8.439	0.433
NNW	26	105076	68505	37234	28176	1.144	1.149	2.152	1.103	5.548	0.285
NNW	29	327381	187257	96250	50182	0.367	0.420	0.832	0.619	2.239	0.115
NNW	19	289039	162584	126478	79611	0.416	0.484	0.633	0.390	1.924	0.099
NNW	24	314542	192116	126312	71455	0.382	0.410	0.634	0.435	1.861	0.095
NW	15	11350	10679	7203	6553	13.729	7.854	8.481	1.422	31.486	2.154
NW	14	44253	34387	29588	24897	3.521	2.439	2.065	0.374	8.399	0.575
NW	30	13809	7066	4359	2759	11.284	11.870	14.015	3.378	40.547	2.774
NW	20	16093	9992	6105	3022	9.683	8.394	10.007	3.084	31.168	2.133
NW	25	50631	29688	19181	10009	3.078	2.825	3.185	0.931	10.019	0.686
NW	24	47554	38134	22578	13585	3.277	2.199	2.706	0.686	8.868	0.607
NW	26	240625	68750	40104	45833	0.648	1.220	1.523	0.203	3.594	0.246

Total Annual Concentrations

Receptor Number	Total concentration [pCi/m³] accumulated from all wind speed bins given in each wind direction															Total Annual Concentration [pCi/m³]	
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.464	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.492	
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.236	0.165	0.000	0.000	0.000	0.000	0.000	0.400	
3	0.000	0.000	0.000	0.000	0.222	0.000	0.000	0.000	0.390	0.286	0.135	0.000	0.000	0.000	0.000	1.033	
4	0.000	0.000	0.000	0.000	0.000	0.524	0.456	0.713	0.039	0.000	0.000	0.000	0.000	0.000	0.000	1.732	
5	0.000	0.000	0.000	0.000	0.000	0.683	1.109	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.819	
6	0.000	0.000	0.000	0.000	0.065	0.425	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.534	
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.069	0.359	0.508	0.000	0.000	0.000	0.000	0.935	
8	0.028	0.133	0.000	0.000	0.000	0.000	0.000	0.000	0.187	0.583	0.499	0.000	0.000	0.000	0.000	1.430	
9	0.000	0.014	0.000	0.033	0.744	1.616	2.324	1.484	0.332	0.000	0.000	0.000	0.000	0.000	0.000	6.547	
10	0.000	0.000	0.000	0.000	0.432	0.678	2.174	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.284	
11	0.000	0.000	0.000	0.000	0.127	0.111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.238	
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.669	0.034	0.000	0.703	
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.907	0.196	0.000	1.103	
14	0.865	0.781	0.737	2.339	6.011	0.634	0.000	0.000	0.000	0.000	0.000	8.928	0.135	0.030	0.575	1.337	22.374
15	0.125	0.033	0.036	0.064	0.200	2.280	6.907	1.215	0.014	0.003	0.010	0.654	5.928	6.967	2.154	0.780	27.371
16	0.000	0.008	0.000	0.071	0.007	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.108	
17	0.000	0.000	0.000	0.043	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.074	
18	0.000	0.000	0.000	0.040	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.058	
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.370	0.408	0.000	0.099	2.876
20	0.039	0.017	0.000	0.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.550	2.133	0.541	4.323
21	0.120	0.034	0.028	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.110	0.318
22	0.000	0.022	0.028	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	
23	0.000	0.000	0.018	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.051	
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.117	0.607	0.095	1.819	
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.686	0.433	1.118	
26	0.067	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.246	0.285	0.608	
27	0.030	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	
28	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	
29	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.115	0.153	
30	0.606	0.125	0.232	0.528	0.341	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.019	1.747	2.774	2.155	10.528

Grid Coordinates and Overall Concentration Inputs for Contour Plot

Conversion from UC Grid to UTM Coordinates

UC Grid Ref Points (Hearst Mining Circle = 0,0)

UTME = 565448

UTMN = 4191869

Correction Angle = 16.71666667 degrees

Presumed toxic emission per year =

30 Ci/yr

Receptor Number	Receptor Location				Overall Total Concentrations [pCi/m³]
	UC Coordinates		UTM Coordinates		
	East (ft)	North (ft)	UTME	UTMN	
1	3500	2000	566294	4192760	0.4918
2	4500	1500	566630	4192701	0.4003
3	4000	1500	566484	4192658	1.0334
4	3500	1500	566338	4192614	1.7317
5	3000	1500	566192	4192570	1.8194
6	2500	1500	566046	4192526	0.5339
7	4500	1000	566674	4192555	0.9353
8	4000	1000	566528	4192512	1.4303
9	3500	1000	566382	4192468	6.5466
10	3000	1000	566236	4192424	3.2835
11	2500	1000	566090	4192380	0.2380
12	5000	500	566864	4192453	0.7032
13	4500	500	566718	4192409	1.1030
14	4000	500	566572	4192366	22.3736
15	3500	500	566426	4192322	27.3706
16	3000	500	566280	4192278	0.1082
17	2500	500	566134	4192234	0.0741
18	2000	500	565988	4192190	0.0575
19	4500	0	566762	4192264	2.8765
20	4000	0	566616	4192220	4.3226
21	3500	0	566470	4192176	0.3181
22	3000	0	566324	4192132	0.0801
23	2500	0	566178	4192088	0.0508
24	4500	-500	566805	4192118	1.8188
25	4000	-500	566660	4192074	1.1184
26	3500	-500	566514	4192030	0.6083
27	3000	-500	566368	4191986	0.0462
28	2500	-500	566222	4191942	0.0132
29	3500	-1000	566557	4191884	0.1533
30	3937.5	250	566576	4192287	10.5282

*** Change total annual emission to obtain corresponding concentrations*

Appendix C

CAP88-PC Files

<u>FILE</u>	<u>PAGE</u>
Synopsis Report	C.2
Weather Data	C.6
Dose and Risk Conversion Factors.....	C.9
Concentration Tables	C.12
CHI/Q Tables	C.20
General Data	C.23

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Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Apr 20, 2001 8:28 am

Facility: Lawrence Berkeley National Laboratory (LBNL)
Address: EH&S Environmental Protection Group
One Cyclotron Road
City: Berkeley
State: CA Zip: 94720

Effective Dose Equivalent
(mrem/year)

9.09E-02

At This Location: 100 Meters East

Source Category: Building 75 NTLF (New Roof Stack)
Source Type: Stack
Emission Year: 1998

Comments: Henry H. Tran, C.H.P.
Environmental Protection Health Physicist

Dataset Name: NTLF-NEWSTACK
Dataset Date: Feb 12, 2001 3:40 pm
Wind File: WNDFILES\LBL98.WND

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 100 Meters East
Lifetime Fatal Cancer Risk: 2.47E-06

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Dose Equivalent (mrem/y)
GONADS	8.70E-02
BREAST	8.70E-02
R MAR	8.65E-02
LUNGS	8.73E-02
THYROID	8.66E-02
ENDOST	6.87E-02
RMNDR	1.02E-01
EFFEC	9.09E-02

Apr 20, 2001 8:28 am

SYNOPSIS
Page 2

RADIONUCLIDE EMISSIONS DURING THE YEAR 1998

Nuclide	Class	Size	Source	
			#1 Ci/y	TOTAL Ci/y
H-3	*	0.00	3.0E+01	3.0E+01

SITE INFORMATION

Temperature: 10 degrees C
Precipitation: 100 cm/y
Mixing Height: 700 m

Apr 20, 2001 8:28 am

SYNOPSIS
Page 3

SOURCE INFORMATION

Source Number: 1

Stack Height (m): 9.10
Diameter (m): 0.57

Plume Rise
Momentum (m/s): 1.19E+01
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.076	0.000	0.008
Fraction From Assessment Area:	0.924	1.000	0.992
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

50	60	80	100	120	150	200	300	400	500
750	1500	2500	3500	4500	7500	15000	35000	55000	80000

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Version 1.00

Clean Air Act Assessment Package - 1988

W E A T H E R D A T A

Non-Radon Individual Assessment
Apr 20, 2001 8:28 am

Facility: Lawrence Berkeley National Laboratory (LBNL)
Address: EH&S Environmental Protection Group
One Cyclotron Road
City: Berkeley
State: CA Zip: 94720

Source Category: Building 75 NTLF (New Roof Stack)
Source Type: Stack
Emission Year: 1998

Comments: Henry H. Tran, C.H.P.
Environmental Protection Health Physicist

Dataset Name: NTLF-NEWSTACK
Dataset Date: Feb 12, 2001 3:40 pm
Wind File: WNDFILES\LBL98.WND

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

Pasquill Stability Class

Dir	A	B	C	D	E	F	G	Wind Frequency
N	0.819	1.423	1.154	1.293	2.196	1.099	0.000	0.056
NNW	1.120	1.530	1.202	2.264	0.964	1.055	0.000	0.079
NW	0.888	1.289	1.967	3.174	1.320	0.966	0.000	0.134
WNW	1.055	1.007	1.226	1.711	1.103	0.838	0.000	0.084
W	1.393	2.460	2.774	1.375	1.044	0.905	0.000	0.041
WSW	1.232	1.625	3.466	2.771	1.341	0.908	0.000	0.019
SW	0.975	0.000	0.000	0.772	1.230	0.841	0.000	0.010
SSW	0.874	0.000	0.000	1.466	0.843	0.824	0.000	0.011
S	0.898	1.052	1.638	3.040	1.590	0.923	0.000	0.027
SSE	1.055	1.187	1.968	2.008	1.716	0.888	0.000	0.069
SE	0.988	1.875	1.465	1.267	1.022	0.839	0.000	0.065
ESE	0.868	1.059	1.310	1.900	1.401	0.961	0.000	0.112
E	0.860	1.389	1.654	2.412	2.180	1.111	0.000	0.131
ENE	0.932	1.612	1.359	0.000	1.749	1.336	0.000	0.073
NE	1.061	1.301	0.901	0.000	0.000	0.981	0.000	0.046
NNE	0.976	1.406	1.385	1.594	4.373	1.033	0.000	0.040

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

Pasquill Stability Class

Dir	A	B	C	D	E	F	G
N	0.920	2.070	1.752	2.448	3.181	1.552	0.000
NNW	1.572	2.173	2.233	4.012	1.585	1.466	0.000
NW	1.108	1.924	3.226	4.456	1.867	1.290	0.000
WNW	1.463	1.372	1.969	2.692	1.545	0.975	0.000
W	1.919	2.998	4.118	3.141	1.523	1.162	0.000
WSW	1.732	2.863	3.700	3.792	2.178	1.158	0.000
SW	1.309	0.000	0.000	0.772	2.092	0.982	0.000
SSW	1.074	0.000	0.000	1.990	0.989	0.936	0.000
S	1.133	1.937	2.132	3.553	2.266	1.193	0.000
SSE	1.463	1.672	2.437	2.775	2.435	1.108	0.000
SE	1.334	2.415	2.229	1.951	1.402	0.977	0.000
ESE	1.058	1.487	1.987	2.793	1.927	1.279	0.000
E	1.035	2.042	2.452	3.213	2.462	1.572	0.000
ENE	1.215	2.164	1.908	0.000	2.209	1.858	0.000
NE	1.473	1.873	1.181	0.000	0.000	1.321	0.000
NNE	1.311	2.067	1.911	3.027	4.373	1.446	0.000

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

Pasquill Stability Class

Dir	A	B	C	D	E	F	G
N	0.0991	0.2969	0.1536	0.0283	0.0120	0.4101	0.0000
NNW	0.0650	0.2735	0.0985	0.0275	0.0289	0.5066	0.0000
NW	0.0136	0.0214	0.1470	0.3760	0.1419	0.3000	0.0000
WNW	0.0355	0.0082	0.0246	0.4665	0.1747	0.2905	0.0000
W	0.0608	0.0358	0.0746	0.3343	0.1520	0.3425	0.0000
WSW	0.1809	0.0359	0.0480	0.1445	0.0844	0.5063	0.0000
SW	0.1086	0.0000	0.0000	0.0105	0.0429	0.8381	0.0000
SSW	0.1201	0.0000	0.0000	0.0298	0.0798	0.7704	0.0000
S	0.0832	0.0124	0.0164	0.2282	0.1453	0.5145	0.0000
SSE	0.0427	0.0164	0.0230	0.3398	0.3236	0.2545	0.0000
SE	0.0562	0.0405	0.1196	0.2548	0.2056	0.3233	0.0000
ESE	0.0448	0.0843	0.4787	0.0579	0.1362	0.1982	0.0000
E	0.0712	0.2241	0.4500	0.0391	0.0434	0.1720	0.0000
ENE	0.1013	0.3987	0.1901	0.0000	0.0155	0.2943	0.0000
NE	0.1926	0.3349	0.0875	0.0000	0.0000	0.3850	0.0000
NNE	0.1420	0.3751	0.0853	0.0226	0.0027	0.3721	0.0000
TOT	0.0692	0.1467	0.1863	0.1691	0.1079	0.3207	0.0000

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 10.0 degrees C
 283.2 K
 Precipitation: 100.0 cm/y
 Lid Height: 700 meters
 Surface Roughness Length: 0.010 meters
 Height Of Wind Measurements: 10.0 meters
 Average Wind Speed: 2.000 m/s

Vertical Temperature Gradients:

STABILITY E 0.073 k/m
 STABILITY F 0.109 k/m
 STABILITY G 0.146 k/m

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K C O N V E R S I O N F A C T O R S

Non-Radon Individual Assessment
Apr 20, 2001 8:28 am

Facility: Lawrence Berkeley National Laboratory (LBNL)
Address: EH&S Environmental Protection Group
One Cyclotron Road
City: Berkeley
State: CA Zip: 94720

Source Category: Building 75 NTLF (New Roof Stack)
Source Type: Stack
Emission Year: 1998

Comments: Henry H. Tran, C.H.P.
Environmental Protection Health Physicist

Dataset Name: NTLF-NEWSTACK
Dataset Date: Feb 12, 2001 3:40 pm
Wind File: WNDFILES\LBL98.WND

DOSE AND RISK FACTOR UNITS

The units for each type of dose rate conversion factor are shown below, by pathway:

Pathway	Units
Ingestion	millirem/picoCurie
Inhalation	millirem/picoCurie
Immersion	millirem-cubic centimeter/microCurie-year
Surface	millirem-square centimeter/microCurie-year

Risks for internal exposures (inhalation and ingestion) are the lifetime risk of premature death in a birth cohort of 100,000 people for a 1 picoCurie/year intake rate, where the average lifetime is 70.7565 years. This is simplified to lifetime risk per 100,000 picoCuries.

The units for each type of risk conversion factor are shown below, by pathway:

Pathway	Units
Ingestion	lifetime risk/100,000 picoCuries
Inhalation	lifetime risk/100,000 picoCuries
Immersion	lifetime risk-cubic centimeter/100,000 picoCurie-years
Surface	lifetime risk-square centimeter/100,000 picoCurie-years

 * NUCLIDE H-3 *

DOSE RATE CONVERSION FACTORS

Organ	Ingestion	Inhalation	Air Immersion	Ground Surface
GONADS	8.300E-08	1.250E-07	0.000E+00	0.000E+00
BREAST	8.300E-08	1.250E-07	0.000E+00	0.000E+00
R MAR	8.260E-08	1.240E-07	0.000E+00	0.000E+00
LUNGS	8.360E-08	1.250E-07	0.000E+00	0.000E+00
THYROID	8.280E-08	1.240E-07	0.000E+00	0.000E+00
ENDOST	6.560E-08	9.850E-08	0.000E+00	0.000E+00
RMNDR	1.078E-07	1.326E-07	0.000E+00	0.000E+00
EFFEC	8.993E-08	1.263E-07	0.000E+00	0.000E+00

GENETIC EFFECT DOSE RATE CONVERSION FACTORS

	TESTES	OVARI ES	AVERAGE	
	2.490E-06	3.750E-06	0.000E+00	0.000E+00
	2.487E-06	3.720E-06	0.000E+00	0.000E+00
	2.488E-06	3.735E-06	0.000E+00	0.000E+00

RISK CONVERSION FACTORS

Cancer	Ingestion	Inhalation	Air Immersion	Ground Surface
LEUKEMIA	2.616E-08	3.927E-08	0.000E+00	0.000E+00
BONE	1.161E-09	1.743E-09	0.000E+00	0.000E+00
THYROID	3.766E-09	5.640E-09	0.000E+00	0.000E+00
BREAST	3.251E-08	4.896E-08	0.000E+00	0.000E+00
LUNG	4.145E-08	6.197E-08	0.000E+00	0.000E+00
STOMACH	3.511E-08	4.064E-08	0.000E+00	0.000E+00
BOWEL	1.927E-08	2.175E-08	0.000E+00	0.000E+00
LIVER	2.903E-08	4.347E-08	0.000E+00	0.000E+00
PANCREAS	1.972E-08	2.960E-08	0.000E+00	0.000E+00
URINARY	1.074E-08	1.619E-08	0.000E+00	0.000E+00
OTHER	2.411E-08	3.620E-08	0.000E+00	0.000E+00

GENETIC EFFECT RISK CONVERSION FACTORS

AVERAGE	6.469E-13	9.711E-13	0.000E+00	0.000E+00

Clean Air Act Assessment Package - 1988

C O N C E N T R A T I O N T A B L E S

Non-Radon Individual Assessment
Apr 20, 2001 8:28 am

Facility: Lawrence Berkeley National Laboratory (LBNL)
Address: EH&S Environmental Protection Group
One Cyclotron Road
City: Berkeley
State: CA Zip: 94720

Source Category: Building 75 NTLF (New Roof Stack)
Source Type: Stack
Emission Year: 1998

Comments: Henry H. Tran, C.H.P.
Environmental Protection Health Physicist

Dataset Name: NTLF-NEWSTACK
Dataset Date: Feb 12, 2001 3:40 pm
Wind File: WNDFILES\LBL98.WND

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m³)	Dry Deposition Rate (pCi/m²/s)	Wet Deposition Rate (pCi/m²/s)	Ground Deposition Rate (pCi/m²/s)
N	50	H-3	8.4E+00	0.0E+00	0.0E+00	0.0E+00
N	60	H-3	1.3E+01	0.0E+00	0.0E+00	0.0E+00
N	80	H-3	1.7E+01	0.0E+00	0.0E+00	0.0E+00
N	100	H-3	1.7E+01	0.0E+00	0.0E+00	0.0E+00
N	120	H-3	1.5E+01	0.0E+00	0.0E+00	0.0E+00
N	150	H-3	1.3E+01	0.0E+00	0.0E+00	0.0E+00
N	200	H-3	8.8E+00	0.0E+00	0.0E+00	0.0E+00
N	300	H-3	4.8E+00	0.0E+00	0.0E+00	0.0E+00
N	400	H-3	3.3E+00	0.0E+00	0.0E+00	0.0E+00
N	500	H-3	2.8E+00	0.0E+00	0.0E+00	0.0E+00
N	750	H-3	2.5E+00	0.0E+00	0.0E+00	0.0E+00
N	1500	H-3	1.3E+00	0.0E+00	0.0E+00	0.0E+00
N	2500	H-3	6.5E-01	0.0E+00	0.0E+00	0.0E+00
N	3500	H-3	4.1E-01	0.0E+00	0.0E+00	0.0E+00
N	4500	H-3	3.0E-01	0.0E+00	0.0E+00	0.0E+00
N	7500	H-3	1.5E-01	0.0E+00	0.0E+00	0.0E+00
N	15000	H-3	6.7E-02	0.0E+00	0.0E+00	0.0E+00
N	35000	H-3	2.7E-02	0.0E+00	0.0E+00	0.0E+00
N	55000	H-3	1.6E-02	0.0E+00	0.0E+00	0.0E+00
N	80000	H-3	1.1E-02	0.0E+00	0.0E+00	0.0E+00
NNW	50	H-3	1.2E+01	0.0E+00	0.0E+00	0.0E+00
NNW	60	H-3	1.6E+01	0.0E+00	0.0E+00	0.0E+00
NNW	80	H-3	2.0E+01	0.0E+00	0.0E+00	0.0E+00
NNW	100	H-3	1.9E+01	0.0E+00	0.0E+00	0.0E+00
NNW	120	H-3	1.7E+01	0.0E+00	0.0E+00	0.0E+00
NNW	150	H-3	1.3E+01	0.0E+00	0.0E+00	0.0E+00
NNW	200	H-3	9.1E+00	0.0E+00	0.0E+00	0.0E+00
NNW	300	H-3	5.0E+00	0.0E+00	0.0E+00	0.0E+00
NNW	400	H-3	3.7E+00	0.0E+00	0.0E+00	0.0E+00
NNW	500	H-3	3.6E+00	0.0E+00	0.0E+00	0.0E+00
NNW	750	H-3	3.7E+00	0.0E+00	0.0E+00	0.0E+00
NNW	1500	H-3	2.1E+00	0.0E+00	0.0E+00	0.0E+00
NNW	2500	H-3	1.1E+00	0.0E+00	0.0E+00	0.0E+00
NNW	3500	H-3	7.1E-01	0.0E+00	0.0E+00	0.0E+00
NNW	4500	H-3	5.1E-01	0.0E+00	0.0E+00	0.0E+00
NNW	7500	H-3	2.7E-01	0.0E+00	0.0E+00	0.0E+00
NNW	15000	H-3	1.2E-01	0.0E+00	0.0E+00	0.0E+00
NNW	35000	H-3	4.6E-02	0.0E+00	0.0E+00	0.0E+00
NNW	55000	H-3	2.8E-02	0.0E+00	0.0E+00	0.0E+00
NNW	80000	H-3	1.9E-02	0.0E+00	0.0E+00	0.0E+00
NW	50	H-3	3.7E+00	0.0E+00	0.0E+00	0.0E+00
NW	60	H-3	7.1E+00	0.0E+00	0.0E+00	0.0E+00
NW	80	H-3	1.3E+01	0.0E+00	0.0E+00	0.0E+00
NW	100	H-3	1.7E+01	0.0E+00	0.0E+00	0.0E+00
NW	120	H-3	1.8E+01	0.0E+00	0.0E+00	0.0E+00
NW	150	H-3	1.7E+01	0.0E+00	0.0E+00	0.0E+00
NW	200	H-3	1.5E+01	0.0E+00	0.0E+00	0.0E+00

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m³)	Dry Deposition Rate (pCi/m²/s)	Wet Deposition Rate (pCi/m²/s)	Ground Deposition Rate (pCi/m²/s)
NW	300	H-3	1. 1E+01	0. 0E+00	0. 0E+00	0. 0E+00
NW	400	H-3	8. 4E+00	0. 0E+00	0. 0E+00	0. 0E+00
NW	500	H-3	7. 1E+00	0. 0E+00	0. 0E+00	0. 0E+00
NW	750	H-3	5. 8E+00	0. 0E+00	0. 0E+00	0. 0E+00
NW	1500	H-3	3. 0E+00	0. 0E+00	0. 0E+00	0. 0E+00
NW	2500	H-3	1. 5E+00	0. 0E+00	0. 0E+00	0. 0E+00
NW	3500	H-3	9. 7E-01	0. 0E+00	0. 0E+00	0. 0E+00
NW	4500	H-3	7. 0E-01	0. 0E+00	0. 0E+00	0. 0E+00
NW	7500	H-3	3. 6E-01	0. 0E+00	0. 0E+00	0. 0E+00
NW	15000	H-3	1. 5E-01	0. 0E+00	0. 0E+00	0. 0E+00
NW	35000	H-3	5. 9E-02	0. 0E+00	0. 0E+00	0. 0E+00
NW	55000	H-3	3. 6E-02	0. 0E+00	0. 0E+00	0. 0E+00
NW	80000	H-3	2. 4E-02	0. 0E+00	0. 0E+00	0. 0E+00
NNW	50	H-3	3. 1E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	60	H-3	3. 8E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	80	H-3	5. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	100	H-3	8. 2E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	120	H-3	1. 0E+01	0. 0E+00	0. 0E+00	0. 0E+00
NNW	150	H-3	1. 1E+01	0. 0E+00	0. 0E+00	0. 0E+00
NNW	200	H-3	1. 2E+01	0. 0E+00	0. 0E+00	0. 0E+00
NNW	300	H-3	9. 5E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	400	H-3	7. 5E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	500	H-3	6. 1E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	750	H-3	4. 3E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	1500	H-3	2. 2E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	2500	H-3	1. 2E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNW	3500	H-3	7. 5E-01	0. 0E+00	0. 0E+00	0. 0E+00
NNW	4500	H-3	5. 4E-01	0. 0E+00	0. 0E+00	0. 0E+00
NNW	7500	H-3	2. 8E-01	0. 0E+00	0. 0E+00	0. 0E+00
NNW	15000	H-3	1. 2E-01	0. 0E+00	0. 0E+00	0. 0E+00
NNW	35000	H-3	4. 5E-02	0. 0E+00	0. 0E+00	0. 0E+00
NNW	55000	H-3	2. 7E-02	0. 0E+00	0. 0E+00	0. 0E+00
NNW	80000	H-3	1. 7E-02	0. 0E+00	0. 0E+00	0. 0E+00
W	50	H-3	3. 1E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	60	H-3	3. 6E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	80	H-3	4. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	100	H-3	5. 6E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	120	H-3	6. 1E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	150	H-3	6. 3E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	200	H-3	5. 8E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	300	H-3	4. 5E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	400	H-3	3. 5E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	500	H-3	3. 0E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	750	H-3	2. 3E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	1500	H-3	1. 2E+00	0. 0E+00	0. 0E+00	0. 0E+00
W	2500	H-3	6. 1E-01	0. 0E+00	0. 0E+00	0. 0E+00
W	3500	H-3	3. 9E-01	0. 0E+00	0. 0E+00	0. 0E+00

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m³)	Dry Deposition Rate (pCi/m²/s)	Wet Deposition Rate (pCi/m²/s)	Ground Deposition Rate (pCi/m²/s)
W	4500	H-3	2.8E-01	0.0E+00	0.0E+00	0.0E+00
W	7500	H-3	1.4E-01	0.0E+00	0.0E+00	0.0E+00
W	15000	H-3	6.1E-02	0.0E+00	0.0E+00	0.0E+00
W	35000	H-3	2.3E-02	0.0E+00	0.0E+00	0.0E+00
W	55000	H-3	1.4E-02	0.0E+00	0.0E+00	0.0E+00
W	80000	H-3	9.1E-03	0.0E+00	0.0E+00	0.0E+00
WSW	50	H-3	3.8E+00	0.0E+00	0.0E+00	0.0E+00
WSW	60	H-3	3.9E+00	0.0E+00	0.0E+00	0.0E+00
WSW	80	H-3	3.5E+00	0.0E+00	0.0E+00	0.0E+00
WSW	100	H-3	3.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	120	H-3	2.5E+00	0.0E+00	0.0E+00	0.0E+00
WSW	150	H-3	2.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	200	H-3	1.5E+00	0.0E+00	0.0E+00	0.0E+00
WSW	300	H-3	1.0E+00	0.0E+00	0.0E+00	0.0E+00
WSW	400	H-3	7.7E-01	0.0E+00	0.0E+00	0.0E+00
WSW	500	H-3	7.3E-01	0.0E+00	0.0E+00	0.0E+00
WSW	750	H-3	8.1E-01	0.0E+00	0.0E+00	0.0E+00
WSW	1500	H-3	5.4E-01	0.0E+00	0.0E+00	0.0E+00
WSW	2500	H-3	3.0E-01	0.0E+00	0.0E+00	0.0E+00
WSW	3500	H-3	1.9E-01	0.0E+00	0.0E+00	0.0E+00
WSW	4500	H-3	1.4E-01	0.0E+00	0.0E+00	0.0E+00
WSW	7500	H-3	7.4E-02	0.0E+00	0.0E+00	0.0E+00
WSW	15000	H-3	3.3E-02	0.0E+00	0.0E+00	0.0E+00
WSW	35000	H-3	1.3E-02	0.0E+00	0.0E+00	0.0E+00
WSW	55000	H-3	7.9E-03	0.0E+00	0.0E+00	0.0E+00
WSW	80000	H-3	5.2E-03	0.0E+00	0.0E+00	0.0E+00
SW	50	H-3	1.1E+00	0.0E+00	0.0E+00	0.0E+00
SW	60	H-3	1.1E+00	0.0E+00	0.0E+00	0.0E+00
SW	80	H-3	1.0E+00	0.0E+00	0.0E+00	0.0E+00
SW	100	H-3	7.8E-01	0.0E+00	0.0E+00	0.0E+00
SW	120	H-3	6.1E-01	0.0E+00	0.0E+00	0.0E+00
SW	150	H-3	4.4E-01	0.0E+00	0.0E+00	0.0E+00
SW	200	H-3	3.1E-01	0.0E+00	0.0E+00	0.0E+00
SW	300	H-3	2.1E-01	0.0E+00	0.0E+00	0.0E+00
SW	400	H-3	1.8E-01	0.0E+00	0.0E+00	0.0E+00
SW	500	H-3	2.3E-01	0.0E+00	0.0E+00	0.0E+00
SW	750	H-3	4.6E-01	0.0E+00	0.0E+00	0.0E+00
SW	1500	H-3	4.3E-01	0.0E+00	0.0E+00	0.0E+00
SW	2500	H-3	2.5E-01	0.0E+00	0.0E+00	0.0E+00
SW	3500	H-3	1.7E-01	0.0E+00	0.0E+00	0.0E+00
SW	4500	H-3	1.2E-01	0.0E+00	0.0E+00	0.0E+00
SW	7500	H-3	6.6E-02	0.0E+00	0.0E+00	0.0E+00
SW	15000	H-3	3.0E-02	0.0E+00	0.0E+00	0.0E+00
SW	35000	H-3	1.2E-02	0.0E+00	0.0E+00	0.0E+00
SW	55000	H-3	7.2E-03	0.0E+00	0.0E+00	0.0E+00
SW	80000	H-3	4.8E-03	0.0E+00	0.0E+00	0.0E+00
SSW	50	H-3	1.1E+00	0.0E+00	0.0E+00	0.0E+00

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m³)	Dry Deposition Rate (pCi/m²/s)	Wet Deposition Rate (pCi/m²/s)	Ground Deposition Rate (pCi/m²/s)
SSW	60	H-3	1.2E+00	0.0E+00	0.0E+00	0.0E+00
SSW	80	H-3	1.2E+00	0.0E+00	0.0E+00	0.0E+00
SSW	100	H-3	1.0E+00	0.0E+00	0.0E+00	0.0E+00
SSW	120	H-3	8.2E-01	0.0E+00	0.0E+00	0.0E+00
SSW	150	H-3	6.2E-01	0.0E+00	0.0E+00	0.0E+00
SSW	200	H-3	4.2E-01	0.0E+00	0.0E+00	0.0E+00
SSW	300	H-3	2.9E-01	0.0E+00	0.0E+00	0.0E+00
SSW	400	H-3	2.6E-01	0.0E+00	0.0E+00	0.0E+00
SSW	500	H-3	2.9E-01	0.0E+00	0.0E+00	0.0E+00
SSW	750	H-3	4.9E-01	0.0E+00	0.0E+00	0.0E+00
SSW	1500	H-3	4.4E-01	0.0E+00	0.0E+00	0.0E+00
SSW	2500	H-3	2.6E-01	0.0E+00	0.0E+00	0.0E+00
SSW	3500	H-3	1.8E-01	0.0E+00	0.0E+00	0.0E+00
SSW	4500	H-3	1.3E-01	0.0E+00	0.0E+00	0.0E+00
SSW	7500	H-3	7.0E-02	0.0E+00	0.0E+00	0.0E+00
SSW	15000	H-3	3.1E-02	0.0E+00	0.0E+00	0.0E+00
SSW	35000	H-3	1.2E-02	0.0E+00	0.0E+00	0.0E+00
SSW	55000	H-3	7.5E-03	0.0E+00	0.0E+00	0.0E+00
SSW	80000	H-3	5.0E-03	0.0E+00	0.0E+00	0.0E+00
S	50	H-3	2.0E+00	0.0E+00	0.0E+00	0.0E+00
S	60	H-3	2.5E+00	0.0E+00	0.0E+00	0.0E+00
S	80	H-3	2.7E+00	0.0E+00	0.0E+00	0.0E+00
S	100	H-3	2.7E+00	0.0E+00	0.0E+00	0.0E+00
S	120	H-3	2.6E+00	0.0E+00	0.0E+00	0.0E+00
S	150	H-3	2.3E+00	0.0E+00	0.0E+00	0.0E+00
S	200	H-3	2.1E+00	0.0E+00	0.0E+00	0.0E+00
S	300	H-3	1.6E+00	0.0E+00	0.0E+00	0.0E+00
S	400	H-3	1.3E+00	0.0E+00	0.0E+00	0.0E+00
S	500	H-3	1.2E+00	0.0E+00	0.0E+00	0.0E+00
S	750	H-3	1.3E+00	0.0E+00	0.0E+00	0.0E+00
S	1500	H-3	8.3E-01	0.0E+00	0.0E+00	0.0E+00
S	2500	H-3	4.5E-01	0.0E+00	0.0E+00	0.0E+00
S	3500	H-3	2.9E-01	0.0E+00	0.0E+00	0.0E+00
S	4500	H-3	2.1E-01	0.0E+00	0.0E+00	0.0E+00
S	7500	H-3	1.1E-01	0.0E+00	0.0E+00	0.0E+00
S	15000	H-3	4.9E-02	0.0E+00	0.0E+00	0.0E+00
S	35000	H-3	1.9E-02	0.0E+00	0.0E+00	0.0E+00
S	55000	H-3	1.2E-02	0.0E+00	0.0E+00	0.0E+00
S	80000	H-3	7.7E-03	0.0E+00	0.0E+00	0.0E+00
SSE	50	H-3	3.3E+00	0.0E+00	0.0E+00	0.0E+00
SSE	60	H-3	3.8E+00	0.0E+00	0.0E+00	0.0E+00
SSE	80	H-3	4.8E+00	0.0E+00	0.0E+00	0.0E+00
SSE	100	H-3	5.9E+00	0.0E+00	0.0E+00	0.0E+00
SSE	120	H-3	6.7E+00	0.0E+00	0.0E+00	0.0E+00
SSE	150	H-3	7.5E+00	0.0E+00	0.0E+00	0.0E+00
SSE	200	H-3	8.1E+00	0.0E+00	0.0E+00	0.0E+00
SSE	300	H-3	7.2E+00	0.0E+00	0.0E+00	0.0E+00

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m³)	Dry Deposition Rate (pCi/m²/s)	Wet Deposition Rate (pCi/m²/s)	Ground Deposition Rate (pCi/m²/s)
SSE	400	H-3	5. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
SSE	500	H-3	4. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
SSE	750	H-3	3. 4E+00	0. 0E+00	0. 0E+00	0. 0E+00
SSE	1500	H-3	1. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
SSE	2500	H-3	8. 5E-01	0. 0E+00	0. 0E+00	0. 0E+00
SSE	3500	H-3	5. 4E-01	0. 0E+00	0. 0E+00	0. 0E+00
SSE	4500	H-3	3. 9E-01	0. 0E+00	0. 0E+00	0. 0E+00
SSE	7500	H-3	2. 0E-01	0. 0E+00	0. 0E+00	0. 0E+00
SSE	15000	H-3	8. 5E-02	0. 0E+00	0. 0E+00	0. 0E+00
SSE	35000	H-3	3. 2E-02	0. 0E+00	0. 0E+00	0. 0E+00
SSE	55000	H-3	2. 0E-02	0. 0E+00	0. 0E+00	0. 0E+00
SSE	80000	H-3	1. 3E-02	0. 0E+00	0. 0E+00	0. 0E+00
SE	50	H-3	4. 4E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	60	H-3	5. 6E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	80	H-3	7. 2E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	100	H-3	8. 2E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	120	H-3	8. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	150	H-3	8. 8E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	200	H-3	8. 3E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	300	H-3	7. 0E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	400	H-3	5. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	500	H-3	4. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	750	H-3	3. 5E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	1500	H-3	1. 9E+00	0. 0E+00	0. 0E+00	0. 0E+00
SE	2500	H-3	9. 8E-01	0. 0E+00	0. 0E+00	0. 0E+00
SE	3500	H-3	6. 3E-01	0. 0E+00	0. 0E+00	0. 0E+00
SE	4500	H-3	4. 5E-01	0. 0E+00	0. 0E+00	0. 0E+00
SE	7500	H-3	2. 3E-01	0. 0E+00	0. 0E+00	0. 0E+00
SE	15000	H-3	1. 0E-01	0. 0E+00	0. 0E+00	0. 0E+00
SE	35000	H-3	3. 9E-02	0. 0E+00	0. 0E+00	0. 0E+00
SE	55000	H-3	2. 3E-02	0. 0E+00	0. 0E+00	0. 0E+00
SE	80000	H-3	1. 5E-02	0. 0E+00	0. 0E+00	0. 0E+00
ESE	50	H-3	6. 6E+00	0. 0E+00	0. 0E+00	0. 0E+00
ESE	60	H-3	1. 2E+01	0. 0E+00	0. 0E+00	0. 0E+00
ESE	80	H-3	2. 4E+01	0. 0E+00	0. 0E+00	0. 0E+00
ESE	100	H-3	3. 1E+01	0. 0E+00	0. 0E+00	0. 0E+00
ESE	120	H-3	3. 2E+01	0. 0E+00	0. 0E+00	0. 0E+00
ESE	150	H-3	3. 0E+01	0. 0E+00	0. 0E+00	0. 0E+00
ESE	200	H-3	2. 3E+01	0. 0E+00	0. 0E+00	0. 0E+00
ESE	300	H-3	1. 4E+01	0. 0E+00	0. 0E+00	0. 0E+00
ESE	400	H-3	1. 0E+01	0. 0E+00	0. 0E+00	0. 0E+00
ESE	500	H-3	7. 6E+00	0. 0E+00	0. 0E+00	0. 0E+00
ESE	750	H-3	4. 9E+00	0. 0E+00	0. 0E+00	0. 0E+00
ESE	1500	H-3	2. 1E+00	0. 0E+00	0. 0E+00	0. 0E+00
ESE	2500	H-3	1. 0E+00	0. 0E+00	0. 0E+00	0. 0E+00
ESE	3500	H-3	6. 4E-01	0. 0E+00	0. 0E+00	0. 0E+00
ESE	4500	H-3	4. 6E-01	0. 0E+00	0. 0E+00	0. 0E+00

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m³)	Dry Deposition Rate (pCi/m²/s)	Wet Deposition Rate (pCi/m²/s)	Ground Deposition Rate (pCi/m²/s)
ESE	7500	H-3	2.3E-01	0.0E+00	0.0E+00	0.0E+00
ESE	15000	H-3	9.7E-02	0.0E+00	0.0E+00	0.0E+00
ESE	35000	H-3	3.8E-02	0.0E+00	0.0E+00	0.0E+00
ESE	55000	H-3	2.3E-02	0.0E+00	0.0E+00	0.0E+00
ESE	80000	H-3	1.6E-02	0.0E+00	0.0E+00	0.0E+00
E	50	H-3	1.7E+01	0.0E+00	0.0E+00	0.0E+00
E	60	H-3	2.9E+01	0.0E+00	0.0E+00	0.0E+00
E	80	H-3	4.3E+01	0.0E+00	0.0E+00	0.0E+00
E	100	H-3	4.6E+01	0.0E+00	0.0E+00	0.0E+00
E	120	H-3	4.4E+01	0.0E+00	0.0E+00	0.0E+00
E	150	H-3	3.7E+01	0.0E+00	0.0E+00	0.0E+00
E	200	H-3	2.6E+01	0.0E+00	0.0E+00	0.0E+00
E	300	H-3	1.4E+01	0.0E+00	0.0E+00	0.0E+00
E	400	H-3	9.2E+00	0.0E+00	0.0E+00	0.0E+00
E	500	H-3	6.8E+00	0.0E+00	0.0E+00	0.0E+00
E	750	H-3	4.3E+00	0.0E+00	0.0E+00	0.0E+00
E	1500	H-3	1.8E+00	0.0E+00	0.0E+00	0.0E+00
E	2500	H-3	8.5E-01	0.0E+00	0.0E+00	0.0E+00
E	3500	H-3	5.2E-01	0.0E+00	0.0E+00	0.0E+00
E	4500	H-3	3.7E-01	0.0E+00	0.0E+00	0.0E+00
E	7500	H-3	1.8E-01	0.0E+00	0.0E+00	0.0E+00
E	15000	H-3	7.9E-02	0.0E+00	0.0E+00	0.0E+00
E	35000	H-3	3.1E-02	0.0E+00	0.0E+00	0.0E+00
E	55000	H-3	1.9E-02	0.0E+00	0.0E+00	0.0E+00
E	80000	H-3	1.3E-02	0.0E+00	0.0E+00	0.0E+00
ENE	50	H-3	1.5E+01	0.0E+00	0.0E+00	0.0E+00
ENE	60	H-3	2.1E+01	0.0E+00	0.0E+00	0.0E+00
ENE	80	H-3	2.6E+01	0.0E+00	0.0E+00	0.0E+00
ENE	100	H-3	2.5E+01	0.0E+00	0.0E+00	0.0E+00
ENE	120	H-3	2.2E+01	0.0E+00	0.0E+00	0.0E+00
ENE	150	H-3	1.8E+01	0.0E+00	0.0E+00	0.0E+00
ENE	200	H-3	1.2E+01	0.0E+00	0.0E+00	0.0E+00
ENE	300	H-3	6.4E+00	0.0E+00	0.0E+00	0.0E+00
ENE	400	H-3	4.3E+00	0.0E+00	0.0E+00	0.0E+00
ENE	500	H-3	3.5E+00	0.0E+00	0.0E+00	0.0E+00
ENE	750	H-3	2.6E+00	0.0E+00	0.0E+00	0.0E+00
ENE	1500	H-3	1.2E+00	0.0E+00	0.0E+00	0.0E+00
ENE	2500	H-3	5.6E-01	0.0E+00	0.0E+00	0.0E+00
ENE	3500	H-3	3.5E-01	0.0E+00	0.0E+00	0.0E+00
ENE	4500	H-3	2.5E-01	0.0E+00	0.0E+00	0.0E+00
ENE	7500	H-3	1.3E-01	0.0E+00	0.0E+00	0.0E+00
ENE	15000	H-3	5.6E-02	0.0E+00	0.0E+00	0.0E+00
ENE	35000	H-3	2.2E-02	0.0E+00	0.0E+00	0.0E+00
ENE	55000	H-3	1.4E-02	0.0E+00	0.0E+00	0.0E+00
ENE	80000	H-3	9.1E-03	0.0E+00	0.0E+00	0.0E+00
NE	50	H-3	1.3E+01	0.0E+00	0.0E+00	0.0E+00
NE	60	H-3	1.6E+01	0.0E+00	0.0E+00	0.0E+00

ESTIMATED RADIONUCLIDE CONCENTRATIONS
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (meters)	Nuclide	Air Concentration (pCi/m³)	Dry Deposition Rate (pCi/m²/s)	Wet Deposition Rate (pCi/m²/s)	Ground Deposition Rate (pCi/m²/s)
NE	80	H-3	1. 7E+01	0. 0E+00	0. 0E+00	0. 0E+00
NE	100	H-3	1. 6E+01	0. 0E+00	0. 0E+00	0. 0E+00
NE	120	H-3	1. 4E+01	0. 0E+00	0. 0E+00	0. 0E+00
NE	150	H-3	1. 1E+01	0. 0E+00	0. 0E+00	0. 0E+00
NE	200	H-3	7. 2E+00	0. 0E+00	0. 0E+00	0. 0E+00
NE	300	H-3	3. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
NE	400	H-3	2. 4E+00	0. 0E+00	0. 0E+00	0. 0E+00
NE	500	H-3	2. 0E+00	0. 0E+00	0. 0E+00	0. 0E+00
NE	750	H-3	1. 8E+00	0. 0E+00	0. 0E+00	0. 0E+00
NE	1500	H-3	1. 0E+00	0. 0E+00	0. 0E+00	0. 0E+00
NE	2500	H-3	5. 2E-01	0. 0E+00	0. 0E+00	0. 0E+00
NE	3500	H-3	3. 3E-01	0. 0E+00	0. 0E+00	0. 0E+00
NE	4500	H-3	2. 4E-01	0. 0E+00	0. 0E+00	0. 0E+00
NE	7500	H-3	1. 3E-01	0. 0E+00	0. 0E+00	0. 0E+00
NE	15000	H-3	5. 6E-02	0. 0E+00	0. 0E+00	0. 0E+00
NE	35000	H-3	2. 2E-02	0. 0E+00	0. 0E+00	0. 0E+00
NE	55000	H-3	1. 4E-02	0. 0E+00	0. 0E+00	0. 0E+00
NE	80000	H-3	9. 1E-03	0. 0E+00	0. 0E+00	0. 0E+00
NNE	50	H-3	9. 8E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNE	60	H-3	1. 3E+01	0. 0E+00	0. 0E+00	0. 0E+00
NNE	80	H-3	1. 5E+01	0. 0E+00	0. 0E+00	0. 0E+00
NNE	100	H-3	1. 4E+01	0. 0E+00	0. 0E+00	0. 0E+00
NNE	120	H-3	1. 2E+01	0. 0E+00	0. 0E+00	0. 0E+00
NNE	150	H-3	9. 2E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNE	200	H-3	6. 1E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNE	300	H-3	3. 1E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNE	400	H-3	2. 1E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNE	500	H-3	1. 7E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNE	750	H-3	1. 5E+00	0. 0E+00	0. 0E+00	0. 0E+00
NNE	1500	H-3	8. 4E-01	0. 0E+00	0. 0E+00	0. 0E+00
NNE	2500	H-3	4. 3E-01	0. 0E+00	0. 0E+00	0. 0E+00
NNE	3500	H-3	2. 7E-01	0. 0E+00	0. 0E+00	0. 0E+00
NNE	4500	H-3	2. 0E-01	0. 0E+00	0. 0E+00	0. 0E+00
NNE	7500	H-3	1. 0E-01	0. 0E+00	0. 0E+00	0. 0E+00
NNE	15000	H-3	4. 6E-02	0. 0E+00	0. 0E+00	0. 0E+00
NNE	35000	H-3	1. 8E-02	0. 0E+00	0. 0E+00	0. 0E+00
NNE	55000	H-3	1. 1E-02	0. 0E+00	0. 0E+00	0. 0E+00
NNE	80000	H-3	7. 4E-03	0. 0E+00	0. 0E+00	0. 0E+00

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

C H I / Q T A B L E S

Non-Radon Individual Assessment
Apr 20, 2001 8:28 am

Facility: Lawrence Berkeley National Laboratory (LBNL)
Address: EH&S Environmental Protection Group
One Cyclotron Road
City: Berkeley
State: CA Zip: 94720

Source Category: Building 75 NTLF (New Roof Stack)
Source Type: Stack
Emission Year: 1998

Comments: Henry H. Tran, C.H.P.
Environmental Protection Health Physicist

Dataset Name: NTLF- NEWSTACK
Dataset Date: Feb 12, 2001 3:40 pm
Wind File: WNDFILES\LBL98.WND

GROUND-LEVEL CHI /Q VALUES FOR H-3
CHI /Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

Dir	Distance (meters)							
	50	60	80	100	120	150	200	
N	8.778E-06	1.337E-05	1.765E-05	1.772E-05	1.618E-05	1.327E-05	9.299E-06	
NNW	1.242E-05	1.695E-05	2.058E-05	1.979E-05	1.752E-05	1.393E-05	9.542E-06	
NW	3.911E-06	7.413E-06	1.405E-05	1.768E-05	1.873E-05	1.802E-05	1.554E-05	
WNW	3.304E-06	3.987E-06	6.033E-06	8.618E-06	1.062E-05	1.205E-05	1.209E-05	
W	3.291E-06	3.833E-06	4.888E-06	5.870E-06	6.459E-06	6.641E-06	6.132E-06	
WSW	3.986E-06	4.123E-06	3.673E-06	3.102E-06	2.625E-06	2.102E-06	1.579E-06	
SW	1.122E-06	1.208E-06	1.050E-06	8.232E-07	6.413E-07	4.644E-07	3.243E-07	
SSW	1.109E-06	1.311E-06	1.260E-06	1.050E-06	8.595E-07	6.494E-07	4.465E-07	
S	2.127E-06	2.594E-06	2.862E-06	2.819E-06	2.683E-06	2.458E-06	2.157E-06	
SSE	3.435E-06	4.044E-06	5.085E-06	6.164E-06	7.037E-06	7.908E-06	8.479E-06	
SE	4.672E-06	5.914E-06	7.567E-06	8.604E-06	9.152E-06	9.290E-06	8.771E-06	
ESE	6.920E-06	1.294E-05	2.555E-05	3.244E-05	3.378E-05	3.103E-05	2.436E-05	
E	1.836E-05	3.002E-05	4.512E-05	4.852E-05	4.576E-05	3.838E-05	2.732E-05	
ENE	1.566E-05	2.199E-05	2.710E-05	2.625E-05	2.334E-05	1.860E-05	1.263E-05	
NE	1.333E-05	1.659E-05	1.805E-05	1.648E-05	1.425E-05	1.117E-05	7.522E-06	
NNE	1.031E-05	1.374E-05	1.578E-05	1.457E-05	1.255E-05	9.717E-06	6.430E-06	

Dir	Distance (meters)							
	300	400	500	750	1500	2500	3500	
N	5.051E-06	3.471E-06	2.994E-06	2.595E-06	1.352E-06	6.864E-07	4.343E-07	
NNW	5.286E-06	3.926E-06	3.784E-06	3.884E-06	2.239E-06	1.169E-06	7.475E-07	
NW	1.140E-05	8.816E-06	7.516E-06	6.056E-06	3.130E-06	1.608E-06	1.020E-06	
WNW	1.001E-05	7.863E-06	6.363E-06	4.569E-06	2.343E-06	1.227E-06	7.845E-07	
W	4.769E-06	3.730E-06	3.118E-06	2.409E-06	1.239E-06	6.399E-07	4.071E-07	
WSW	1.047E-06	8.050E-07	7.634E-07	8.522E-07	5.705E-07	3.135E-07	2.044E-07	
SW	2.220E-07	1.916E-07	2.435E-07	4.813E-07	4.469E-07	2.654E-07	1.773E-07	
SSW	3.029E-07	2.715E-07	3.100E-07	5.159E-07	4.676E-07	2.786E-07	1.863E-07	
S	1.666E-06	1.359E-06	1.295E-06	1.373E-06	8.749E-07	4.748E-07	3.080E-07	
SSE	7.549E-06	6.027E-06	4.935E-06	3.556E-06	1.742E-06	8.917E-07	5.658E-07	
SE	7.336E-06	5.946E-06	4.939E-06	3.700E-06	1.954E-06	1.030E-06	6.596E-07	
ESE	1.523E-05	1.046E-05	7.948E-06	5.161E-06	2.247E-06	1.094E-06	6.763E-07	
E	1.500E-05	9.660E-06	7.183E-06	4.571E-06	1.894E-06	8.972E-07	5.490E-07	
ENE	6.683E-06	4.498E-06	3.657E-06	2.703E-06	1.215E-06	5.877E-07	3.647E-07	
NE	3.890E-06	2.510E-06	2.070E-06	1.848E-06	1.048E-06	5.477E-07	3.505E-07	
NNE	3.289E-06	2.167E-06	1.835E-06	1.627E-06	8.825E-07	4.539E-07	2.889E-07	

GROUND-LEVEL CHI /Q VALUES FOR H-3
CHI /Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

Dir	Distance (meters)					
	4500	7500	15000	35000	55000	80000
N	3.125E-07	1.611E-07	7.069E-08	2.801E-08	1.709E-08	1.135E-08
NNW	5.409E-07	2.800E-07	1.232E-07	4.880E-08	2.976E-08	1.974E-08
NW	7.354E-07	3.746E-07	1.611E-07	6.223E-08	3.756E-08	2.473E-08
WNW	5.672E-07	2.900E-07	1.236E-07	4.683E-08	2.803E-08	1.835E-08
W	2.938E-07	1.498E-07	6.400E-08	2.438E-08	1.462E-08	9.589E-09
WSW	1.496E-07	7.816E-08	3.448E-08	1.359E-08	8.268E-09	5.477E-09
SW	1.311E-07	6.958E-08	3.104E-08	1.233E-08	7.528E-09	4.997E-09
SSW	1.379E-07	7.326E-08	3.270E-08	1.299E-08	7.931E-09	5.265E-09
S	2.248E-07	1.169E-07	5.129E-08	2.013E-08	1.222E-08	8.086E-09
SSE	4.081E-07	2.081E-07	8.919E-08	3.416E-08	2.054E-08	1.349E-08
SE	4.775E-07	2.449E-07	1.054E-07	4.058E-08	2.446E-08	1.610E-08
ESE	4.786E-07	2.381E-07	1.017E-07	4.028E-08	2.459E-08	1.634E-08
E	3.860E-07	1.928E-07	8.287E-08	3.305E-08	2.026E-08	1.350E-08
ENE	2.594E-07	1.329E-07	5.840E-08	2.332E-08	1.429E-08	9.520E-09
NE	2.537E-07	1.325E-07	5.885E-08	2.348E-08	1.437E-08	9.565E-09
NNE	2.085E-07	1.086E-07	4.810E-08	1.911E-08	1.168E-08	7.761E-09

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

G E N E R A L D A T A

Non-Radon Individual Assessment
Apr 20, 2001 8:28 am

Facility: Lawrence Berkeley National Laboratory (LBNL)
Address: EH&S Environmental Protection Group
One Cyclotron Road
City: Berkeley
State: CA Zip: 94720

Source Category: Building 75 NTLF (New Roof Stack)
Source Type: Stack
Emission Year: 1998

Comments: Henry H. Tran, C.H.P.
Environmental Protection Health Physicist

Dataset Name: NTLF-NEWSTACK
Dataset Date: Feb 12, 2001 3:40 pm
Wind File: WNDFILES\LBL98.WND

Apr 20, 2001 8:28 am

GENERAL
Page 1

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
H-3	*	0.0	0.00E+00	0.00E+00

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	DECAY CONSTANT (PER DAY)			TRANSFER COEFFICIENT	
	Radioactive (1)	Surface	Water	Milk (2)	Meat (3)
H-3	0.00E+00	5.48E-05	0.00E+00	0.00E+00	0.00E+00

FOOTNOTES:

- (1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2
- (2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)
- (3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

VALUES FOR RADI NUCLIDE-DEPENDENT PARAMETERS

Nucl i de	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTI ON	
	Forage (1)	Edi bl e (2)	Inhal ation	Ingestion
H- 3	0. 00E+00	0. 00E+00	9. 50E- 01	9. 50E- 01

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pasture and forage (in pCi/kg dry weight per pCi/kg dry soil)
(2) Concentration factor for uptake of nuclide from soil by edible parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

H- 3 DOSE CONVERS ION FACTOR FOR WATER INGESTION (rem-cc/pCi -y) : 5. 70E- 02

VALUES FOR RADIONUCLIDE INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/sq m, dry weight) (Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (years)	1.00E+02
For radionuclides deposited on ground/water (days)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transport time from animal feed-milk-man (day)	2.00E+00
Time from slaughter to consumption (day)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/leafy vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/sq m)	2.80E-01
Produce/leafy veg for human consumption (kg/sq m)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01

VALUES FOR RADI ONUCLIDE- INDEPENDENT PARAMETERS

ANIMAL FEED CONSUMPTION FACTORS

Contaminated feed/forage (kg/day, dry weight)	1. 56E+01
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DAIRY PRODUCTIVITY

Milk production of cow (L/day)	1. 10E+01
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MEAT ANIMAL SLAUGHTER PARAMETERS

Muscle mass of animal at slaughter (kg)	2. 00E+02
Fraction of herd slaughtered (per day)	3. 81E-03

DECONTAMINATION

Fraction of radioactivity retained after washing for leafy vegetables and produce	5. 00E-01
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FRACTIONS GROWN IN GARDEN OF INTEREST

Produce ingested	1. 00E+00
Leafy vegetables ingested	1. 00E+00

INGESTION RATIOS:

IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	7. 60E-02
Meat	8. 00E-03
Milk	0. 00E+00

MINIMUM INGESTIONS FROM OUTSIDE AREA

(Minimum fractions of food types from outside area listed below are actual fixed values.)	
Vegetables	0. 00E+00
Meat	0. 00E+00
Milk	0. 00E+00

HUMAN FOOD UTILIZATION FACTORS

Produce ingestion (kg/y)	1. 76E+02
Milk ingestion (L/y)	1. 12E+02
Meat ingestion (kg/y)	8. 50E+01
Leafy vegetable ingestion (kg/y)	1. 80E+01

SWIMMING PARAMETERS

Fraction of time spent swimming	0. 00E+00
Dilution factor for water (cm)	1. 00E+00